

Trouble-shooting instructions : FIA-5001
BOSCH system : LU2-Jetronic
Make of vehicle : FIAT / LANCIA
Basic microcard : PKW-064

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 1.995 l / 4-cyl. engine:

FIAT Croma 2.0 i.e.
LANCIA Thema 2.0 i.e.
CH/D/S version 01.86->

- * LU2-Jetronic with 25-pin control unit:
0 280 000 350.
- * Engine-speed triggering by term. 1 of ignition coil.
- * 5-pin air-flow sensor and 7-pin control relay.
- * Solenoid-operated injection valves with brass-wire coil.
- * Start control
- * In-tank electric fuel pump
- * Lambda closed-loop control with heated sensor.
- * 3-way exhaust-gas catalytic converter
- * For testing the fuel pressure, connect in pressure tester with connecting part KDJE-P 100/14 at fuel-distribution pipe inlet.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 123

Test step	Switch		Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
1	5	-	1 - 5	Voltage pulses from ignition coil term. 1	Shift into neutral, start engine	Ignition pulses on oscilloscope
2	6	-	9 - 5 (+) (-)	Voltage from control relay term. 87	Shift into neutral, start engine	8...15 V
3	7	-	4 - 5 (+) (-)	Voltage from ignition and starting switch term. 50	Shift into neutral, start engine	8...15 V
4	 V	11	8 - 5	Resistor set in air-flow sensor	—	100...200 Ω
5	 V	12	7 - 5	Resistance of potentio- meter in air-flow sensor	Deflect air-flow sensor flap as far as it will go.	60...1000 Ω
6	 V	13	10 - 5	Resistance, temperature sensor (engine)	+15...+30°C: Approx. +80°C:	1,45...3,3 k Ω 280...360 Ω
7	 V	14	13 - 5	Frame connection of output stage		0...10 Ω

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 123

Test step	Switch	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
	V	Ω			
8	 V	16	2 - 9 Resistance of idle contact	Accelerator pedal in rest position : Slightly depress accelerator pedal :	0...10 Ω infinity Ω
9	 V	17	3 - 9 Resistance of full-load contact	Accelerator pedal in rest position : Fully depress accelerator pedal :	infinity Ω 0...10 Ω
10	 V	18	12 - 9 Resistance of shunt- connected solenoid-oper- ated injection valves	+15...+30°C : Approx. +80°C :	7,0...9,5 Ω 7,2...10,0 Ω

REMARK: The following components with respective connecting leads are not covered by the universal test adapter for these tests:

- 1. Auxiliary-air device: positive lead from term. 87 of control relay, negative lead to engine ground.
- 2. Electric fuel pump: positive lead from term. 87b of control relay (via pump fuse), negative lead to vehicle ground.
- 3. Sensor heater: positive lead from term. 87b of control relay (via sensor fuse), negative lead to engine ground.
- 4. Lambda sensor: sensor lead to control unit term. 20 (shielding to term. 5), sensor housing to vehicle ground.

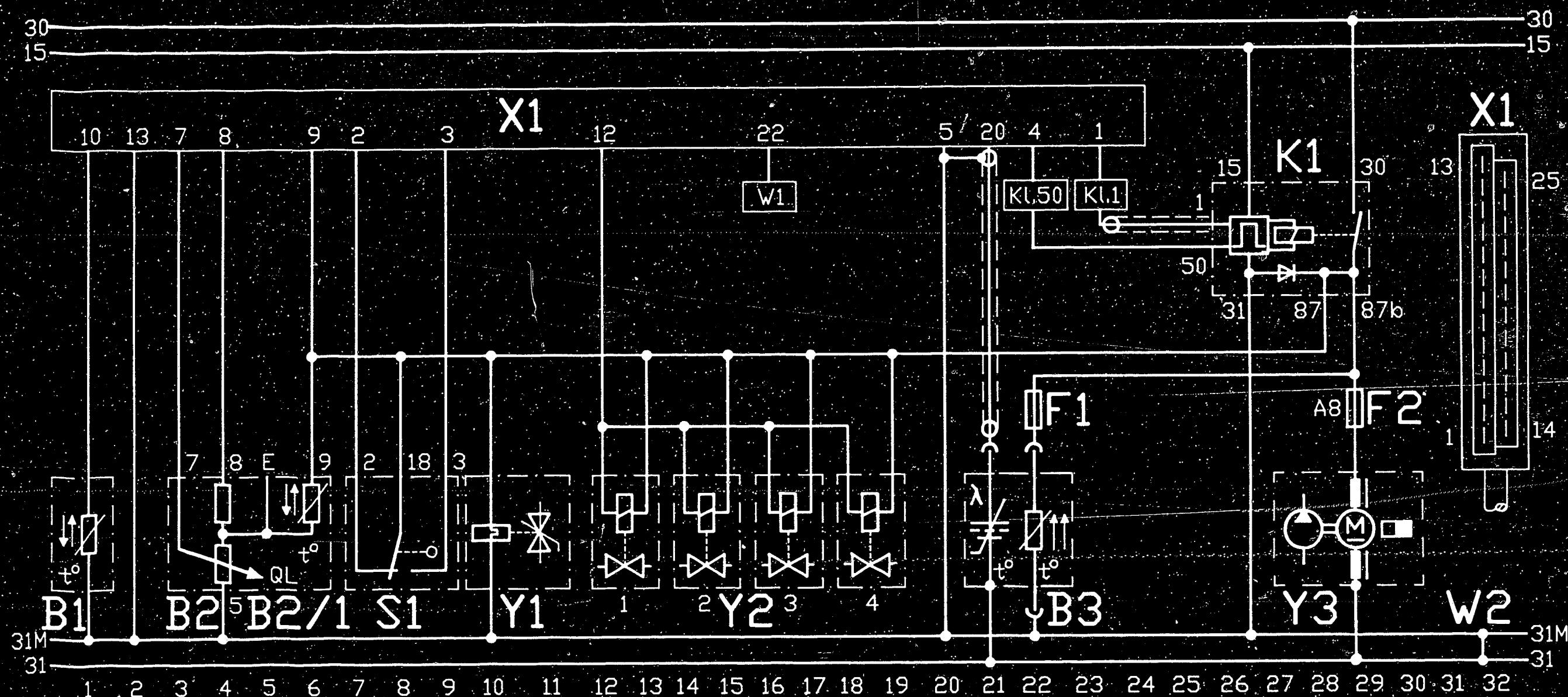
TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Fuel delivery and return:	at least 700 cm ³ /30 s
* Supply voltage under load:	at least 12 V
Pressure regulator	
* Fuel pressure with engine at standstill:	2,8...3,2 bar
at idle:	approx. 0.5 bar lower
Fuel system, leakages	
* Fuel pressure after 20 mins. with engine at standstill:	at least 1.0 bar
Auxiliary-air device	
* Resistance value	35...70 Ω
Air-flow sensor	
* Resistance value between	
term. 8 and term. 5:	340 ... 450 Ω
term. 7 and term. 5:	60 ...1000 Ω 1)
term. 9 and term. 5:	500 ... 760 Ω
term. 8 and term. 9:	160 ... 300 Ω
1) (Fully deflect air-flow sensor flap)	
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature +15...+30°C:	1,45...3,3 k Ω
With engine at warm. op. temp. approx. +80°C :	280...360 Ω
Lambda-sensor heater	
* Internal electrical resistance (PTC) with engine at standstill:	1...15 Ω

TEST SPECIFICATIONS (continued)

Component/function	Set values
Solenoid-operated injection valve	
* Electrical internal resistance at ambient temperature +15...+30°C:	14.5...17.5 Ω
* Leakages after 60 s:	there must be no dripping
Starting control	
* Voltage at injection valve at initiation of starting:	greater than 1.5 V
after approx. 15s:	approx. 0.5 V
Idle-speed adjustment	
Engine at op. temp., approx. +80°C	
* Idle speed:	800...900 min ⁻¹
CO adjustment	not required, lambda closed-loop control
Integrator voltage/test pin term.22	
* Closed-loop control (connected sensor must be hot)	2 voltage values
reading fluctuates between:	
* Open-loop control (separate sensor lead):	voltage reading must be equal to the fluctuating average value.
* Rich value (sensor lead separated, connect to ground on control-unit side):	10...13 V
* Lean value (apply 2 V to sensor lead on control-unit side):	less than approx. 0.5 V

For settings for ignition, valve clearance and other technical engine data, refer to equipment and autodata microcard.



280/1426

ELECTRICAL TERMINAL DIAGRAM

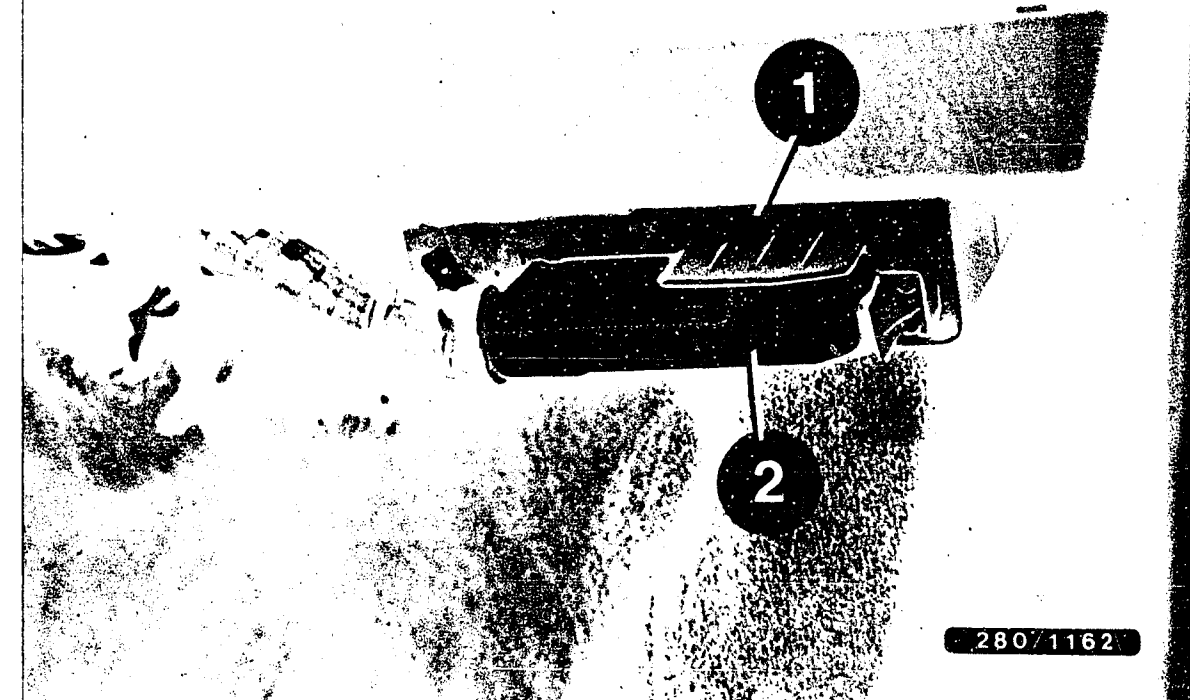
B1 = Temperature sensor (engine)
 B2 = Air-flow sensor
 B2/1= Temperature sensor (intake air)
 B3 = Lambda sensor (heated)
 F1 = Fuse (sensor heater)
 F2 = Fuse (electric fuel pump)
 K1 = Control relay

S1 = Throttle-valve switch
 W1 = Test pin/integrator voltage
 W2 = Ground strap, engine
 X1 = Control-unit plug
 Y1 = Auxiliary-air device
 Y2 = Solenoid-operated injection valves
 Y3 = In-tank electric fuel pump

A11 ———— ➡

➡ A12 ————

For production reasons:
continued on the following
coordinate.



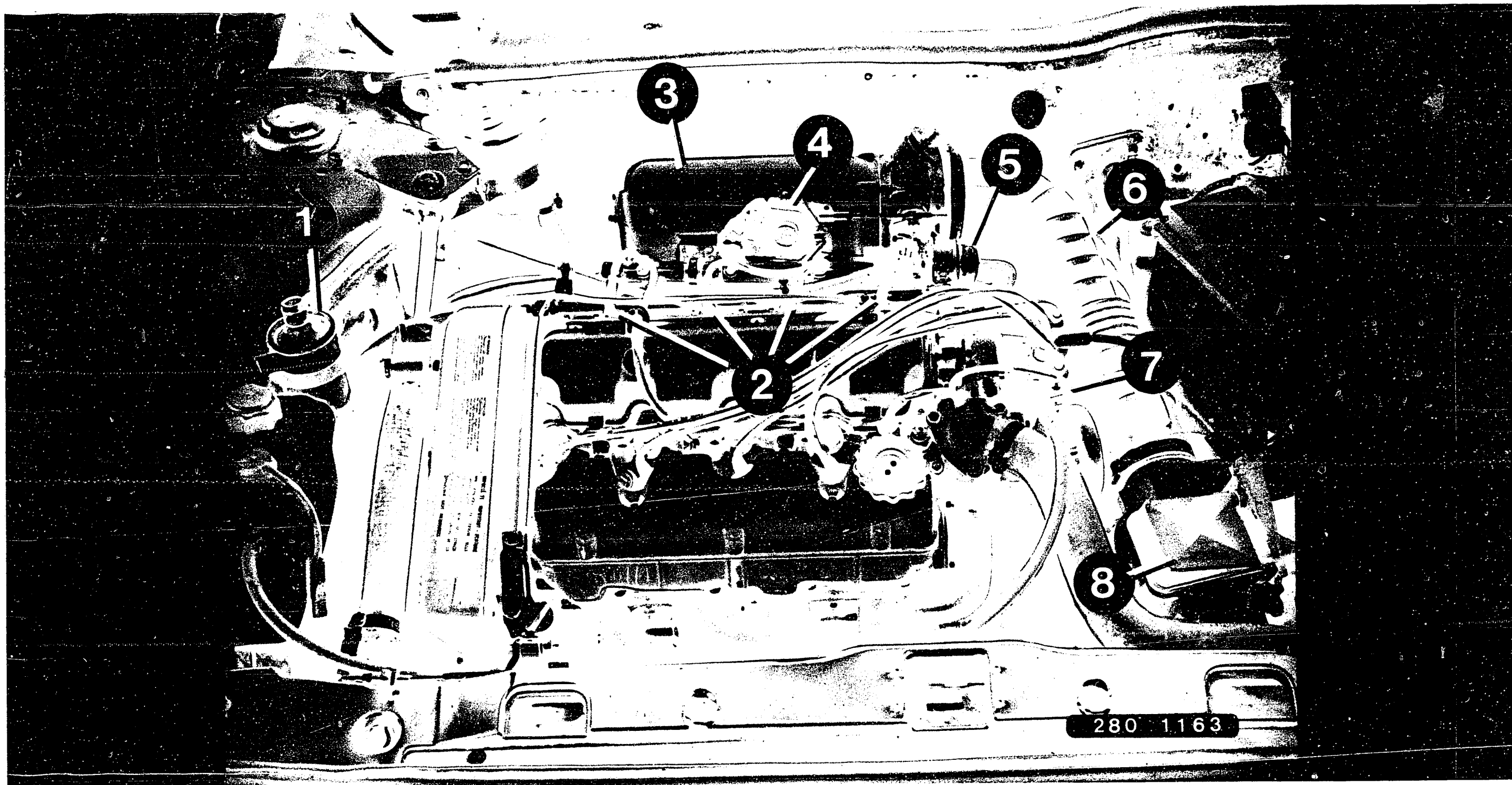
- 1 = Control unit
- 2 = 25-pin control-unit plug

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

* LU-Jetronic control unit in passenger compartment

The control unit is located in the passenger compartment beneath the glove compartment. For testing the electrics using the universal test adapter, press open the latch (locking tongue) and pull off control-unit plug. Connect the 25-pin adapter lead to the periphery.

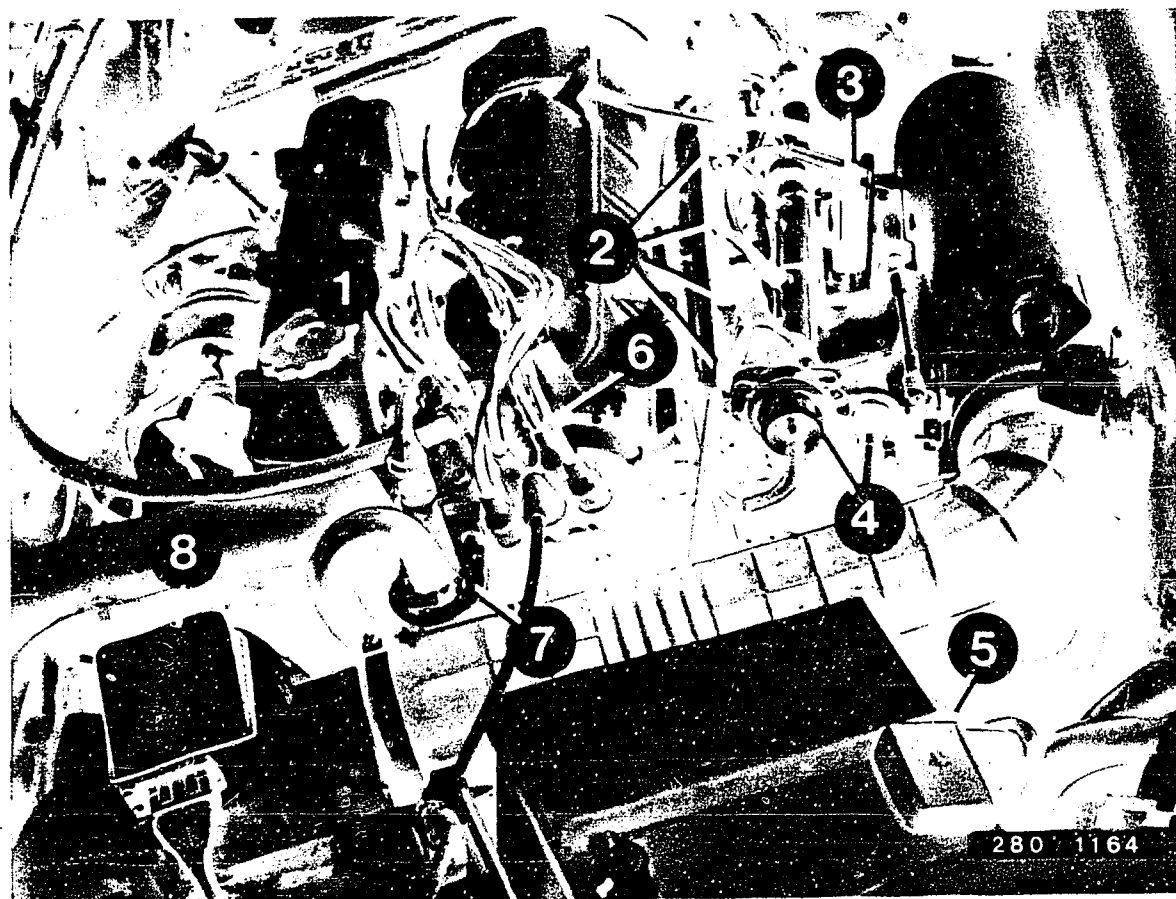


* Layout of components on the engine

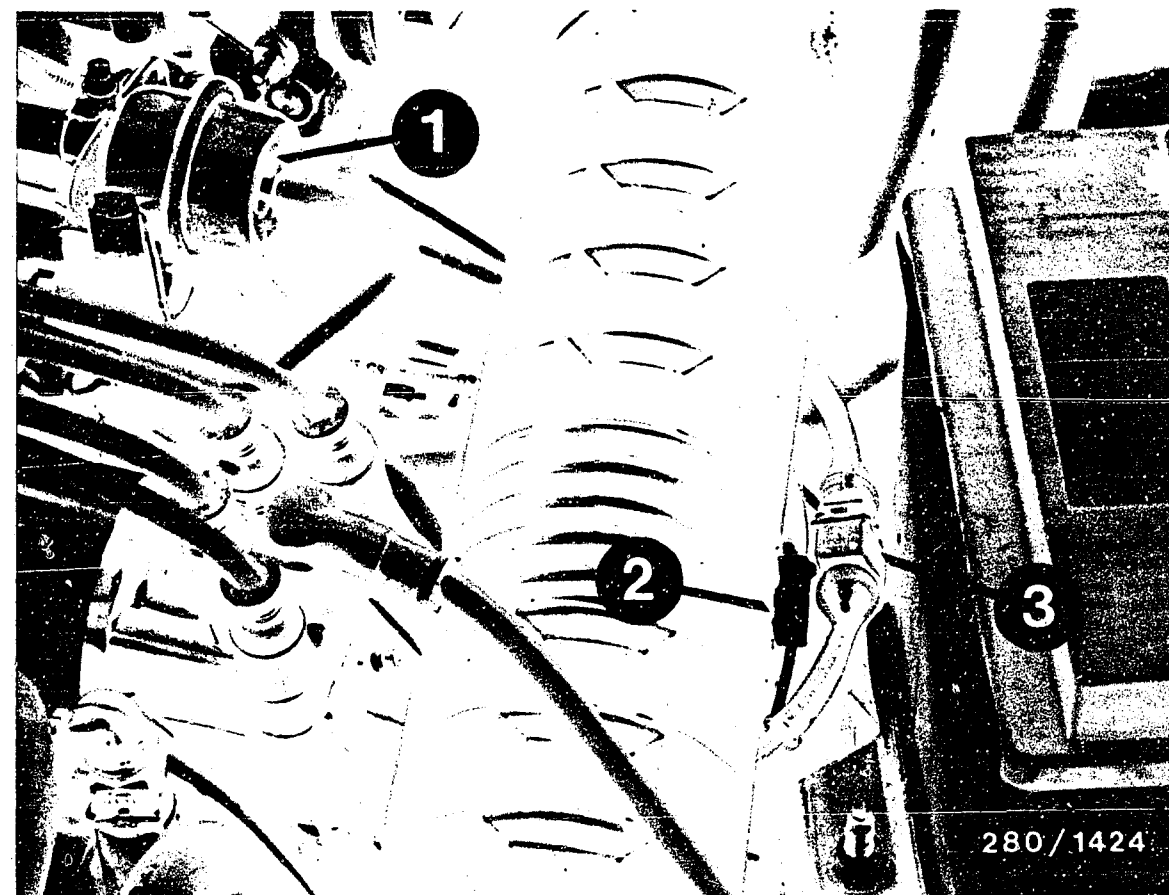
1 = Fuel filter
2 = Solenoid-operated injection valves
with O-ring sealing technique

3 = Intake manifold
4 = Throttle-valve switch
5 = Pressure regulator

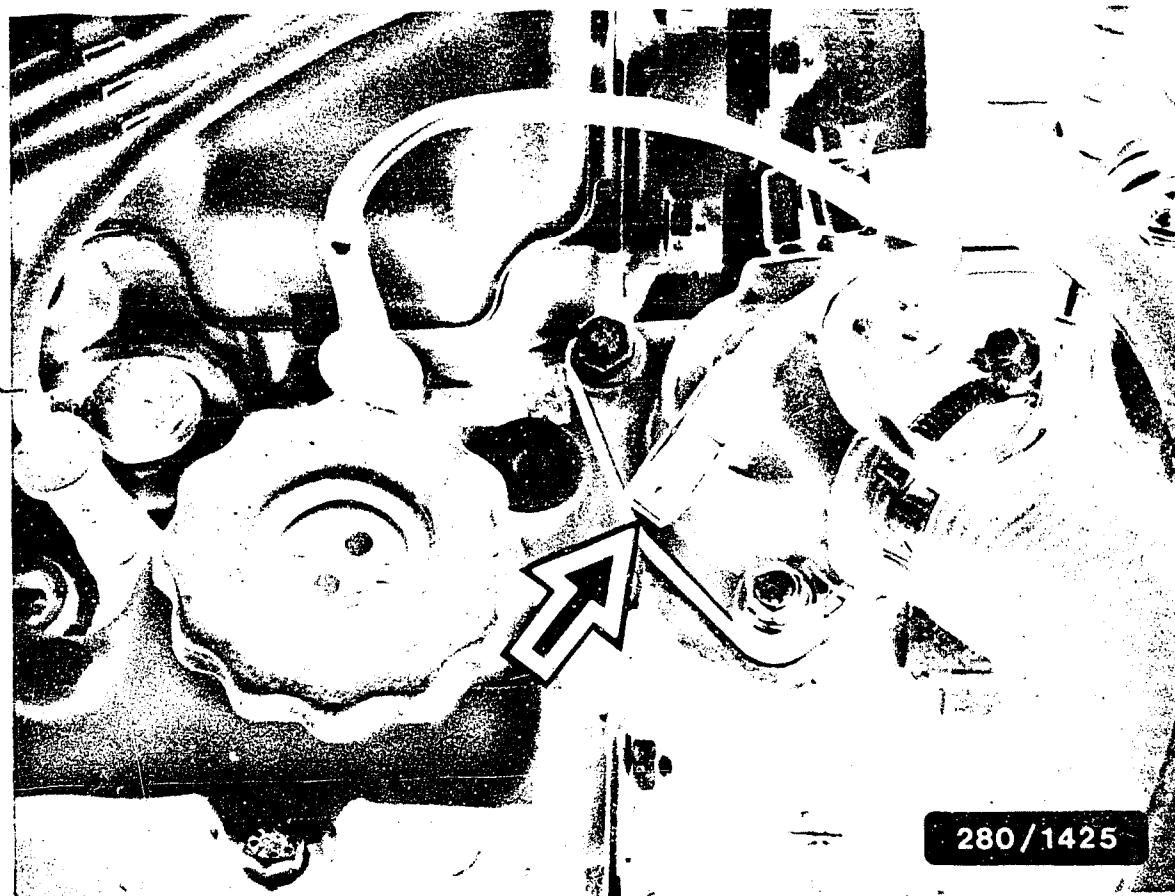
6 = Air guide
7 = Auxiliary-air device
8 = Air-flow sensor



- 1 = Temperature sensor (engine)
- 2 = Solenoid-operated injection valves
- 3 = Throttle-valve switch
- 4 = Pressure regulator
- 5 = To control relay, secure to rear battery holder
- 6 = Ground terminal
- 7 = Auxiliary, air device
- 8 = Air-flow sensor



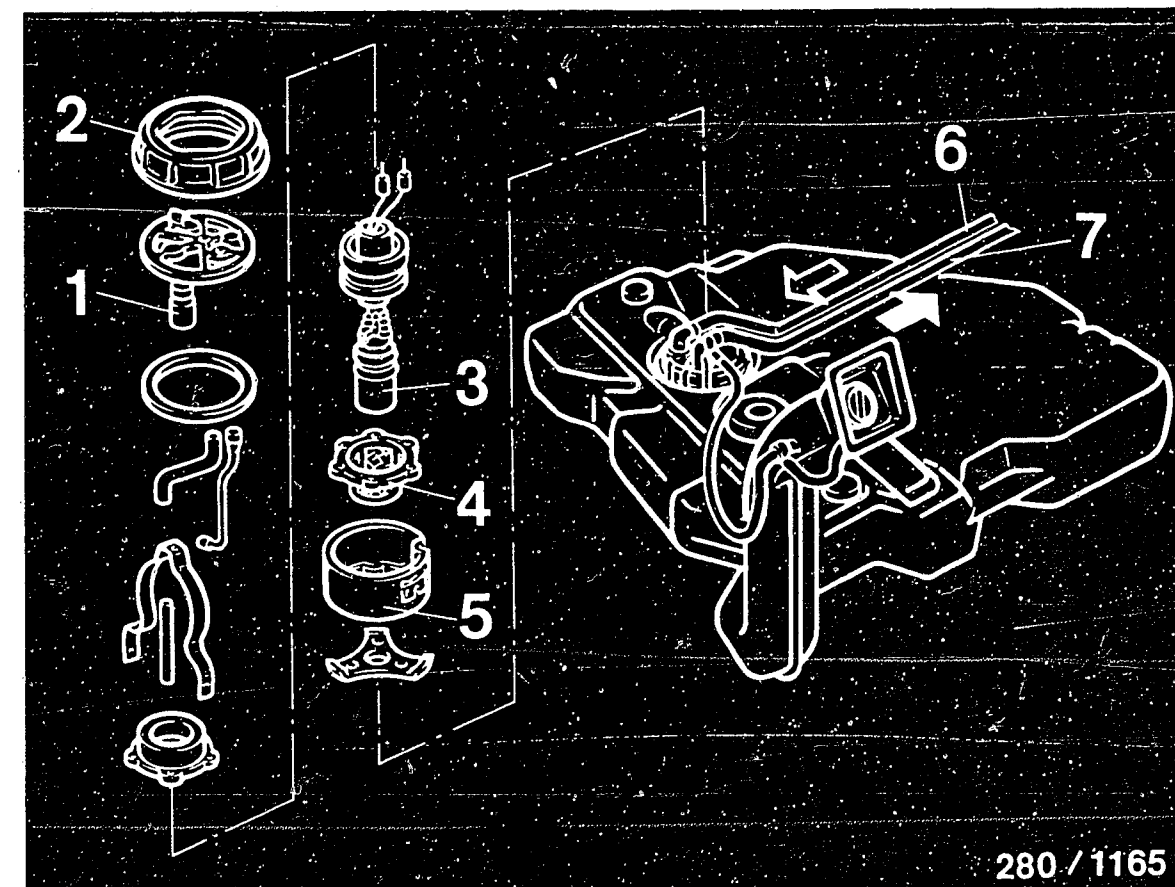
- 1 = Pressure regulator
- 2 = Plug-in connection for lambda sensor signal
- 3 = Plug-in connection for sensor heater



Arrow = Test pin term. 22 from control unit.
Integrator voltage of lambda closed-loop control.

Further installation positions of components

* Lambda sensor in exhaust pipe upstream of the catalytic converter.



* Components of the fuel-supply system

- 1 = Valve
- 2 = Sealing ring
- 3 = In-tank electric fuel pump
- 4 = Fuel strainer
- 5 = Retaining ring
- 6 = Return line
- 7 = Fuel-injection tubing inlet

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults. For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

- * Prevent fuel from being injected during the compression test.
For this reason, disconnect control relay.

For further precautionary measures,
see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

								Cause (component fault)
*	*	*	*	*	*	*	*	Universal test adapter
*								Electric fuel pump
*	*	*	*					Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*	Air-flow sensor/air-mass sensor
*	*	*	*		*			Intake system
		*	*	*		*	*	Solenoid-operated injection valves
*	*	*			*	*		Fuel pressure
				*	*			Fuel quantity
		*	*	*	*	*		Throttle valve
				*				Overrun cut-off
*		*						Start control
				*				Ground
*	*	*	*	*	*			Alternator, interference suppress.
		*	*	*		*		CO exhaust-gas adjustment
				*				Control unit
						*		Catalytic converter
		*	*	*	*			Lambda closed-loop control

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 123

Test step	Switch		Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
	V	Ω				
1	5	-	1 - 5	Voltage pulses from ignition coil term. 1	Shift into neutral, start engine	Ignition pulses on oscilloscope
2	6	-	9 - 5 (+) (-)	Voltage from control relay term. 87	Shift into neutral, start engine	8...15 V
3	7	-	4 - 5 (+) (-)	Voltage from ignition and starting switch term. 50	Shift into neutral, start engine	8...15 V
4	 V	11	8 - 5	Resistor set in air-flow sensor	—	100...200 Ω
5	 V	12	7 - 5	Resistance of potentio- meter in air-flow sensor	Deflect air-flow sensor flap as far as it will go.	60...1000 Ω
6	 V	13	10 - 5	Resistance, temperature sensor (engine)	+15...+30°C: Approx. +80°C:	1,45...3,3 k Ω 280...360 Ω
7	 V	14	13 - 5	Frame connection of output stage		0...10 Ω

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 123

Test step	Switch	Ω	Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
8	 V	16	2 - 9	Resistance of idle contact	Accelerator pedal in rest position : Slightly depress accelerator pedal :	0...10 Ω infinity Ω
9	 V	17	3 - 9	Resistance of full-load contact	Accelerator pedal in rest position : Fully depress accelerator pedal :	infinity Ω 0...10 Ω
10	 V	18	12 - 9	Resistance of shunt- connected solenoid-oper- ated injection valves	+15...+30°C : Approx. +80°C :	6,8...9,3 Ω 7,0...9,8 Ω

REMARK: The following components with respective connecting leads are not covered by the universal test adapter for these tests:

- 1. Auxiliary-air device: positive lead from term. 87 of control relay, negative lead to engine ground.
- 2. Electric fuel pump: positive lead from term. 87b of control relay (via pump fuse), negative lead to vehicle ground.
- 3. Sensor heater: positive lead from term. 87b of control relay (via sensor fuse), negative lead to engine ground.
- 4. Lambda sensor: sensor lead to control unit term. 20 (shielding to term. 5), sensor housing to vehicle ground.

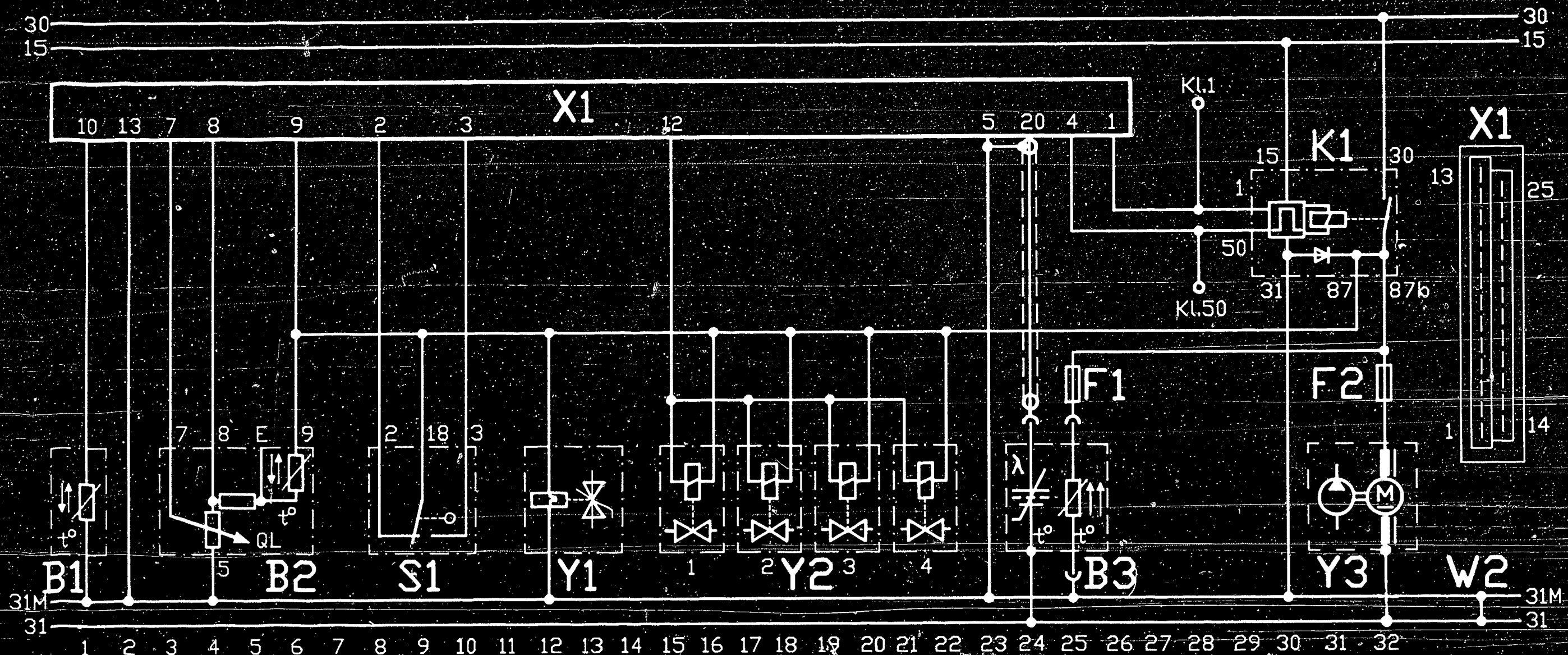
TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Fuel delivery and return:	at least 650 cm ³ /30 s
* Supply voltage under load:	at least 12 V
Pressure regulator	
* Fuel pressure with engine at standstill: at idle:	2,3...2,7 bar approx. 0.5 bar lower
Fuel system, leakages	
* Fuel pressure after 20 mins. with engine at standstill:	at least 1.0 bar
Auxiliary-air device	
* Resistance value	35...70 Ω
Air-flow sensor	
* Resistance value between	
term. 8 and term. 5:	340 ... 450 Ω
term. 7 and term. 5:	60 ...1000 Ω 1)
term. 9 and term. 5:	500 ... 760 Ω
term. 8 and term. 9:	160 ... 300 Ω
1) (Fully deflect air-flow sensor flap)	
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature +15...+30°C:	1,45...3,3 k Ω
With engine at warm. op. temp. approx. +80°C :	280...360 Ω
Lambda-sensor heater	
* Internal electrical resistance (PTC) with engine at standstill:	1...15 Ω

TEST SPECIFICATIONS (continued)

Component/function	Set values
Solenoid-operated injection valve	
* Electrical internal resistance at ambient temperature +15...+30°C:	14.5...17.5 Ω
* Leakages after 60 s:	there must be no dripping
Starting control	
* Voltage at injection valve at initiation of starting: after approx. 15s:	greater than 1.5 V approx. 0.5 V
Idle-speed adjustment	
Engine at op. temp., approx. +80°C	
* Idle speed:	900...950 min ⁻¹
CO adjustment	not required, lambda closed-loop control
Integrator voltage/test pin term.22	
* Closed-loop control (connected sensor must be hot)	
reading fluctuates between:	2 voltage values
* Open-loop control (separate sensor lead):	voltage reading must be equal to the fluctuating average value.
* Rich value (sensor lead separated, connect to ground on control-unit side).	10...13 V
* Lean value (apply 2 V to sensor lead on control-unit side):	less than approx. 0.5 V

For settings for ignition, valve clearance and other technical engine data, refer to equipment and autodata microcard.



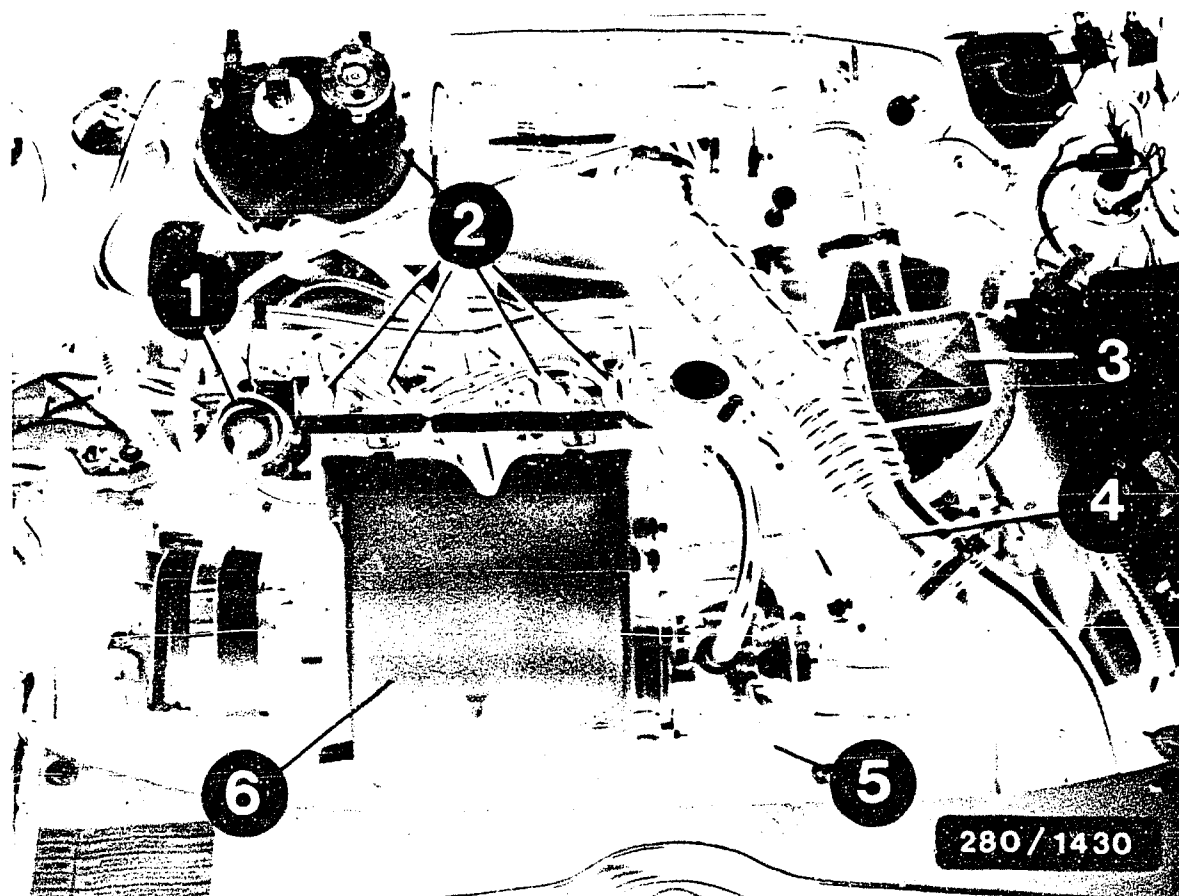
280/1030

- | | |
|----------------------------------|---|
| B1 = Temperature sensor (engine) | W2 = Ground strap (engine) |
| B2 = Air-flow sensor | X1 = Control-unit plug |
| B3 = Heated lambda sensor | Y1 = Auxiliary-air device |
| K1 = Control relay | Y2 = Solenoid-operated injection valves |
| S1 = Throttle-valve switch | Y3 = In-tank electric fuel pump |

ELECTRICAL TERMINAL DIAGRAM

B11 —————>

B12 —————<=



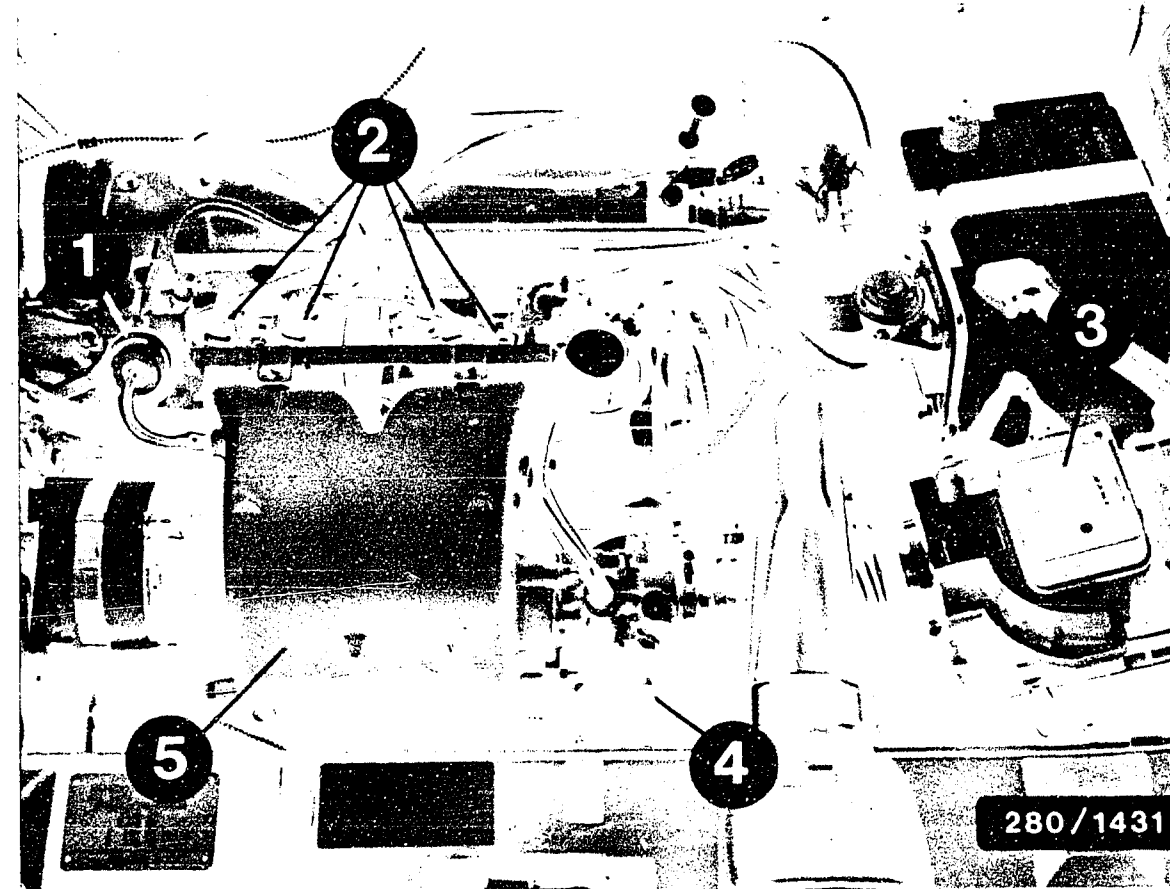
- 1 = Pressure regulator
- 2 = Solenoid-operated injection valves
with O-ring sealing technique
- 3 = Air-flow sensor
- 4 = Air guide
- 5 = Throttle-valve switch
- 6 = Intake manifold

INSTALLATION POSITION OF COMPONENTS

Further components not illustrated

All indications "right" and "left" always refer to the forward direction of travel.

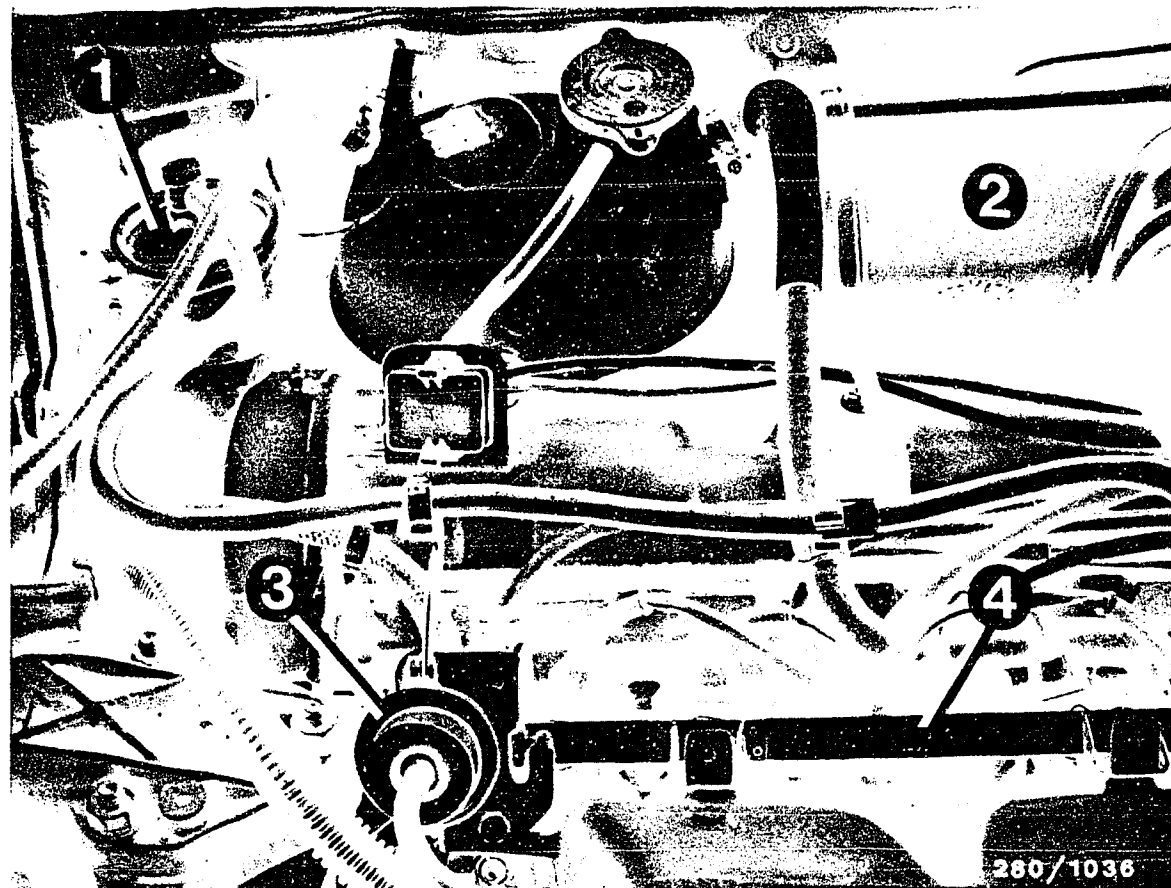
- * Control unit : on passenger's side above the glove compartment.
- * Auxiliary-air device: beneath the ignition distributor on the left-hand side of the engine block.
- * Temperature sensor (engine): on the left-hand side of the engine block next to the auxiliary-air device.



INSTALLATION POSITION OF COMPONENTS

This figure applies to the following model: Peugeot 405

- 1 = Pressure regulator
- 2 = Solenoid-operated injection valves
with O-ring sealing technique
- 3 = Air-flow sensor
- 4 = Throttle-valve switch
- 5 = Intake manifold

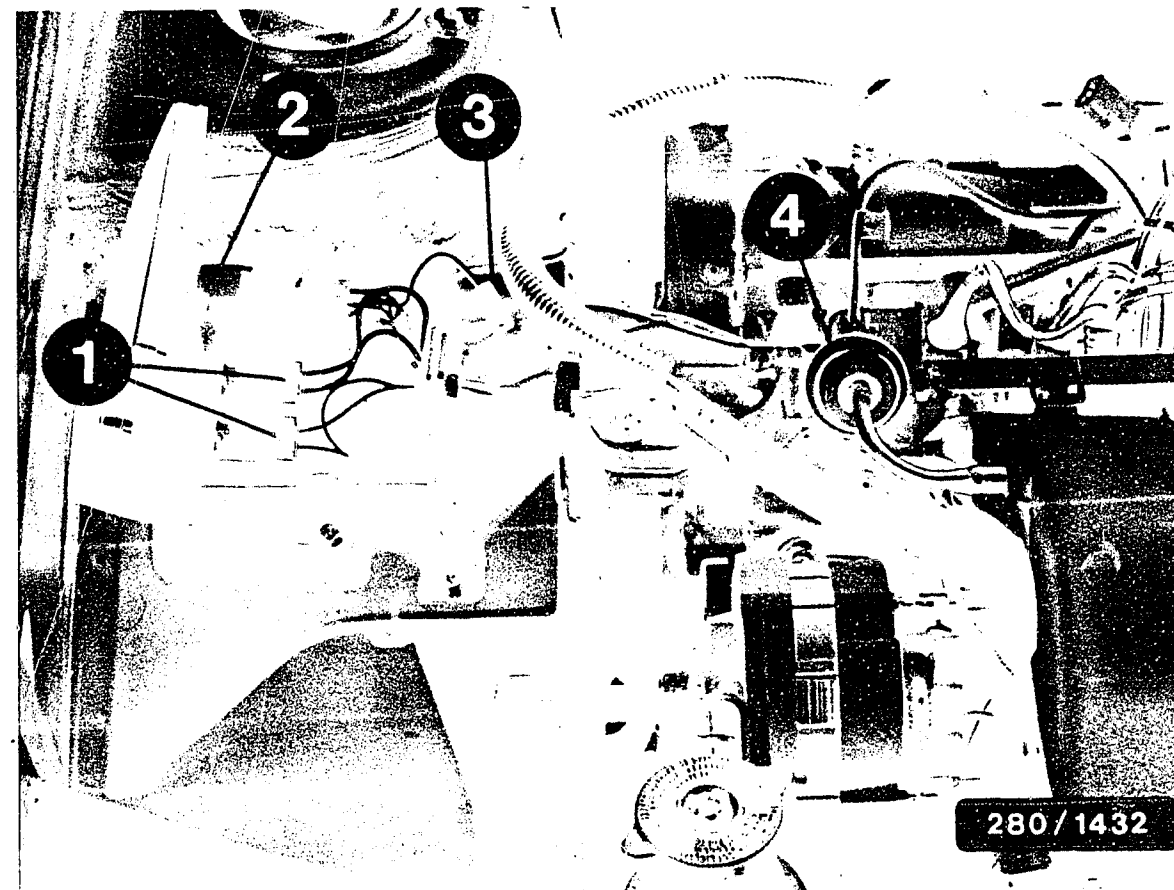


- 1 = Fuel filter
- 2 = Air filter
- 3 = Pressure regulator
- 4 = Fuel-distribution pipe

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Further components not illustrated

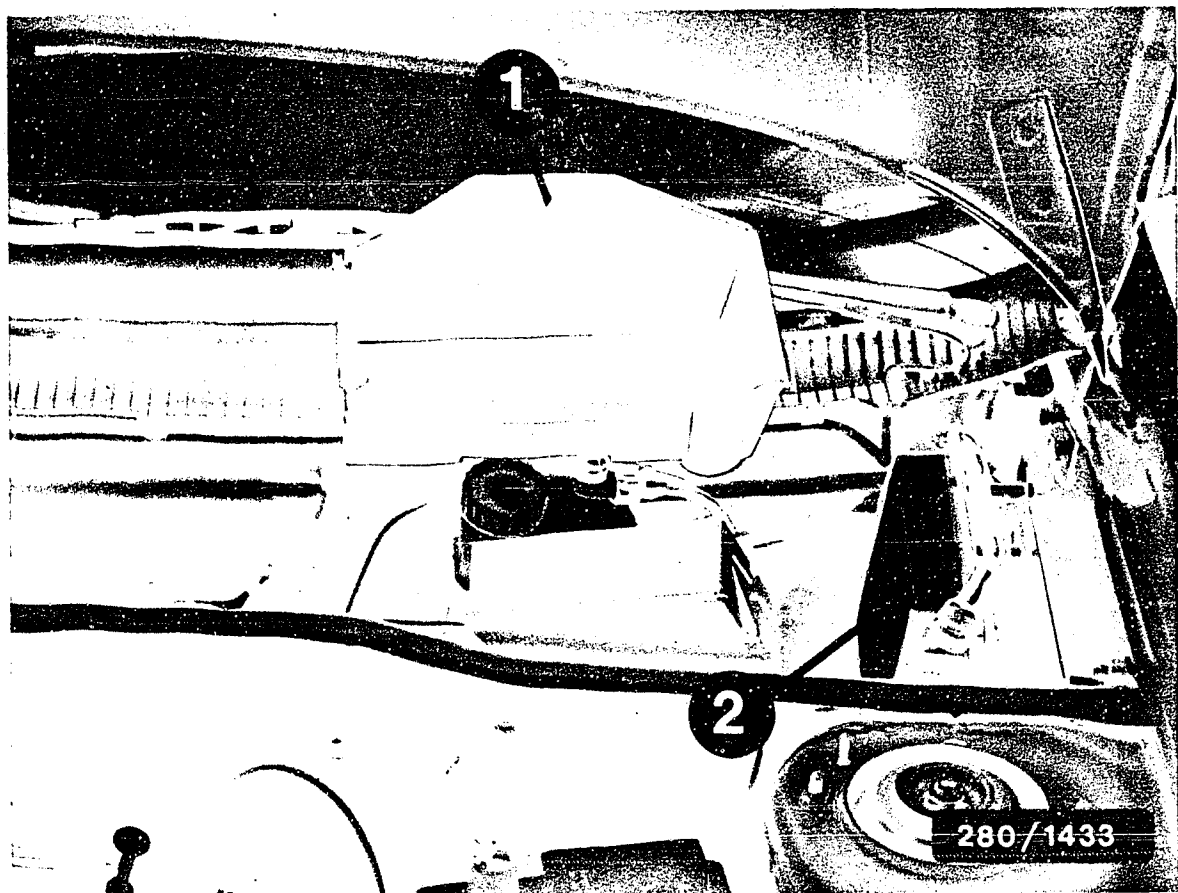
- * Control relay: in front of the battery on the vehicle frame. Protected against splash-water by hood.
- * Central ground: above the control relay
- * In-tank fuel pump, together with a strainer, is mounted vertically on the bracket which in turn is bolted on top of the fuel tank.
- * Test pin, integrator voltage term. 22: in front of the battery near to the control relay.



INSTALLATION POSITION OF COMPONENTS

This figure applies to the following model: Peugeot 405

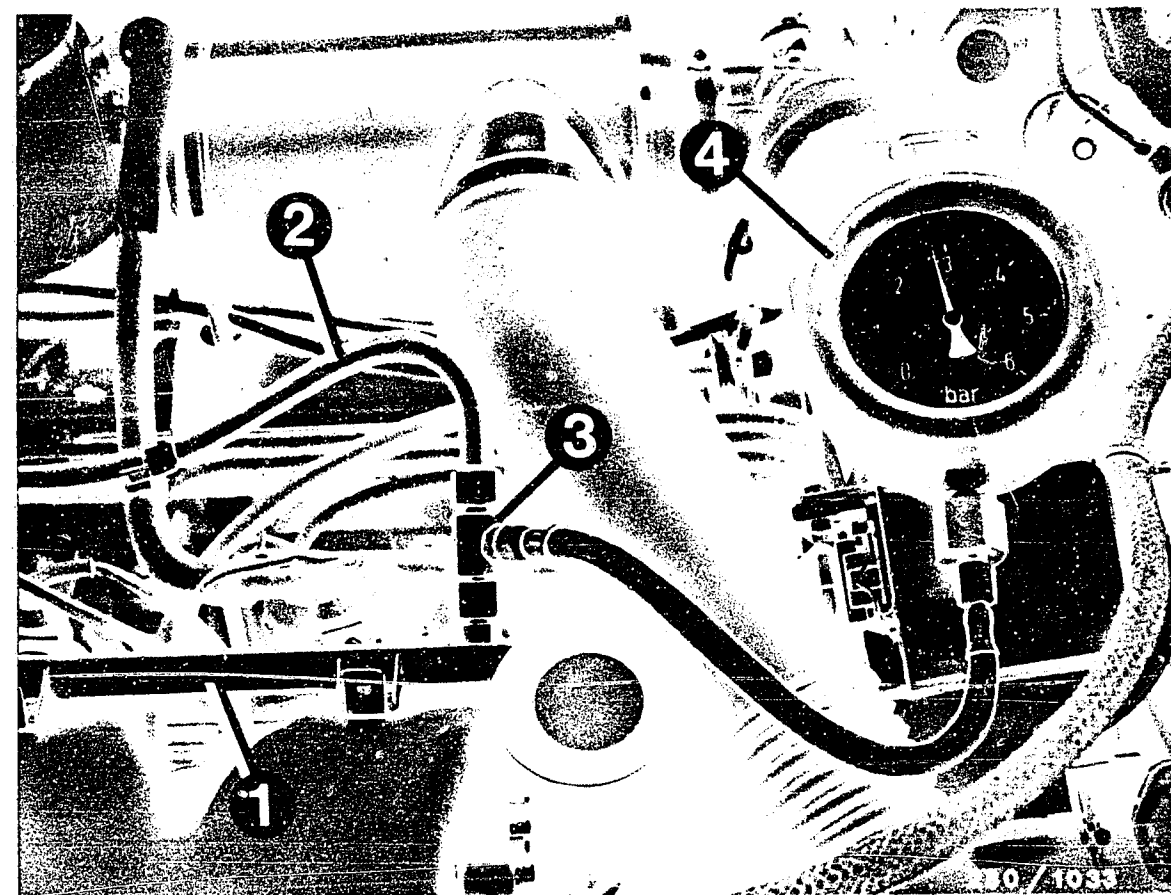
- 1 = Fuse, fuel pump
(leads 76 and 76 A)
Fuse, lambda-sensor heater
(leads 96 and 96A)
- 2 = Control relay
- 3 = Test pin, integrator voltage
(lambda closed-loop control)
- 4 = Pressure regulator



INSTALLATION POSITION OF COMPONENTS

This figure applies to the following model: Peugeot 405

- 1 = Hood
- 2 = Control unit



- 1 = Fuel-distribution pipe
- 2 = Fuel-injection tubing, supply
- 3 = Connecting piece KDJE-P100/14
- 4 = Pressure gauge of pressure tester KDJE-P 100

TESTING THE FUEL PRESSURE

For testing the fuel pressure, use pressure gauge and hose line of pressure tester KDJE-P 100.

Connect in connecting piece KDJE-P 100/14 at the fuel-distribution pipe inlet and connect hose line with pressure gauge to the threaded connector at side.

Attention. When opening the fitting, make sure that no fuel gets on to any hot parts of the engine.

Trouble-shooting instructions : SAA-5002
BOSCH system : LH-Jetronic
Make of vehicle : SAAB
Basic microcard : SAA-504

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 1.985 l/4-cyl. engine:

Saab 9000 i 16V 11.85->
Saab 9000 i 16V US/S/D version 05.86->
with lambda closed-loop control

- * LH2.2-Jetronic with 25-pin control unit:
0 280 000 530, as of 5.87: 0 280 000 553
- * LH2.2-Jetronic with 25-pin control unit and
lambda closed-loop control: 0 280 000 532
- * O-ring connection technique on solenoid-
operated injection valves and pressure regulator.
- * Engine-speed triggering at control unit term. 1
via TD amplifier.
- * Lambda closed-loop control with heated sensor.
- * Mechanical throttle-valve damper.
- * Knock control (APC system, Saab).
- * Fuel cut-off under full-load starting.
- * Low-idle-speed control
- * Start control
- * In-tank pre-supply pump and
in-tank electric fuel pump
- * For testing the fuel pressure, connect pressure
tester with connection piece KDJE-P 100/14 to the
pressure-regulator inlet.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 141

Test step	Switch		Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
	V	Ω				
1	 V	5	2 - 11	Resistance, temperature sensor (engine)	Connect adapter lead only to periphery. +15...+30°C; approx. +80°C;	1.45...3.3 k Ω 280...360 Ω
2	 V	6	25 - 11	Frame connection of output stage		0...10 Ω
3	 V	7	5 - 11	Frame connection of sensors		0...10 Ω
4	 V	8	13 - 11	Resistance of the shunt- connected solenoid- operated injection valve and lead of the sensor heater	Disconnect sensor-heater plug and connect short-circuit wire jumper into the plug on the wiring-harness side. +15...+30°C; approx. +80°C;	6,8...10,5 Ω 7,0...12,0 Ω
5	 V	9	3 - 11	Resistance of the idle contact	(Test of throttle- valve damper) Accelerator pedal in rest position: Slightly depress accelerator pedal: Release accelerator pedal after approx. 3...6 s ;	0...10 Ω infinity Ω 0...10 Ω
6	 V	10	12 - 11	Resistance of full-load contact	 Accelerator pedal in rest position: Fully depress accelerator pedal:	infinity Ω 0...10 Ω
7	 V	10	12 - 11	Resistance of low-idle- speed control test pin	Apply test pin to ground	0...10 Ω
8	 V	11	10 - 11	Resistance of idle actuator, winding 1	Sensor-heater plug remains jumped. +15...+30°C; approx. +80°C;	20...32 Ω 24...37 Ω

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
 Adapter lead: 1 684 463 141

Test step	Switch V Ω	Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
9	 V 12	23 - 11	Resistance of idle actuator, winding 2	Adapter lead remains connected to periphery. +15...+30°C: approx. +80°C: After test, remove jumper from sensor-heater plug and connect sensor.	18...30 Ω 22...34 Ω
10	 V 13	15 - 11	Overrun-cutoff suppression	Not applicable	
11	 V 21	14 - 6	Resistance, idle-mixture potentiometer	Dependent upon the CO adjustment	0...1100 Ω
12	5 21	1 - 11	TD signal from ignition trigger box term. 7 via TD amplifier	Transmission in neutral, start engine	Rectangular pulse on oscilloscope
13	6 21	9 - 11 (+) (-)	Voltage of main relay term. 87	Press push-button 4	8...15 V
14	7 21	18 - 11 (+) (-)	Voltage from ignition and starting switch	Ignition "ON"	8...15 V
15	8 21	21 - 11 (+) (-)	Voltage at main relay term. 85		8...15 V
16	9 21	17 - 11 (+) (-)	Voltage at pump relay term. 85 via charge-air-pressure sensing switch	Press push-button 4	8...15 V

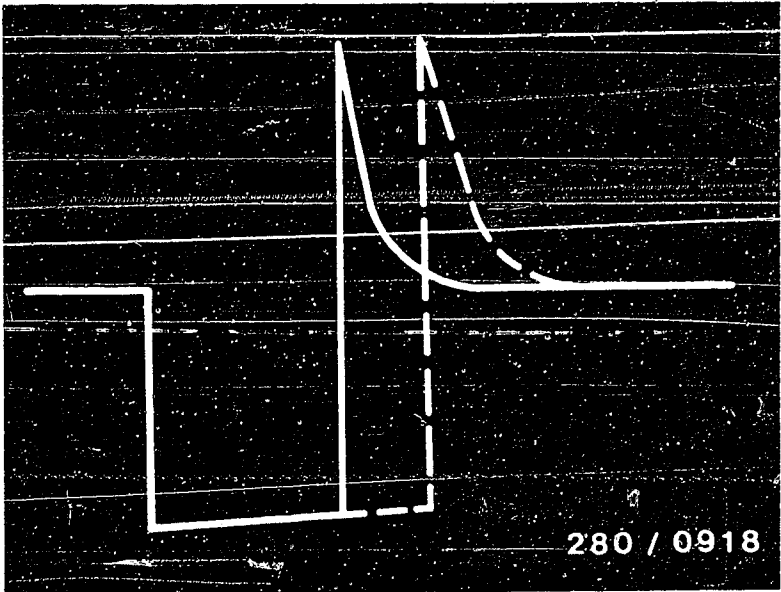
RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 141

Test step	Switch		Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
	V	Ω				
17	10	21	16 - 11	Voltage at auxiliary-fan relay (only when air conditioner fitted)	Connect adapter lead to periphery and control unit. Leave engine running. Switch on air conditioner.	8...15 V
18	3	21	7 - 6	Output voltage, hot-wire air-mass flow sensor	Leave engine running. When engine speed changes, the output voltage must change.	2...5 V
19	11	21	22 - 11	Voltage at integrator output, lambda closed-loop control (open-loop-control value)	With catalytic converter model only. Leave engine running until at normal operating temperature.	10...13 V
20	11	22	22 - 11	Voltage at integrator output, lambda closed-loop control (rich value)	With catalytic-converter model only. Leave engine running until at normal operating temperature.	10...13 V
21	11	23	22 - 11	Voltage at integrator output, lambda closed-loop control (lean value)	With catalytic-converter model only. Leave engine running until at normal operating temperature.	Less than 0.5 V
22	11	24	22 - 11	Voltage at integrator output, lambda closed-loop control (closed-loop-control value)	With catalytic-converter model only. Leave engine running until at normal operating temperature. Take measurement at approx. 2500 min ⁻¹ .	0...13 V oscillating
23	11	24		Basic idle speed	Leave engine running until at normal operating temperature. Apply test pin (low-idle-speed control) to ground.	725...775 min ⁻¹

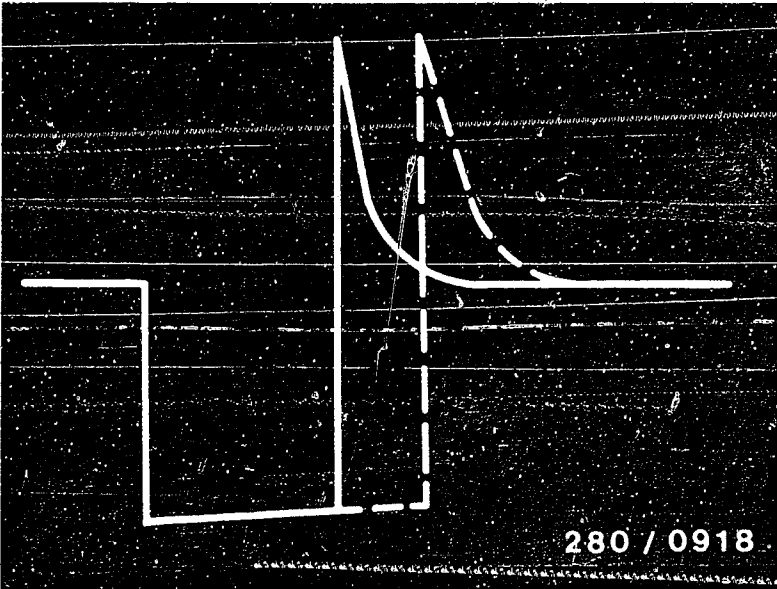
RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test	step	Switch	Termi- nals	Testing of components/function Test instructions/conditions	Set values
		V	Ω		
24	11	24		On/off ratio at idle actuator Measurement with dwell-angle tester at sockets 1 and 2 Apply LFR* test pin to ground : Loosen LFR test pin from ground: In addition, switch on air conditioner (if fitted) : Accelerate; above 3000 min ⁻¹ , on/off ratio must increase : (*LFR = Idle mixture control.)	 29,9 % 31...33 % 34...37 % > 36 %
25	12	24	13 - 11	Injection signal t _i Leave engine running (at normal operating temperature)...	See upper illustration
26	12	24	13 - 11	Injection signal t _i Temperature sensor cold Leave engine running (at normal operating temperature). Press push-button 1. Duration of injection, engine speed and CO content become greater.	See upper illustration
27	12	24	13 - 11	Injection signal t _i Temperature sensor warm Leave engine running (at normal operating temperature). Press push-button 2. Duration of injection must remain constant.	See upper illustration



RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch		Termi- nals	Testing of component/function Test instructions/conditions	Set values
	V	Ω			
28	12	24	13 - 11	Injection signal t ₁ Full-load enrichment Leave engine running (at normal operating temperature). Press push-button 6. Duration of injection, engine speed and CO content become greater.	See upper illustration
29	13	24	8 - 11	Hot-wire air-mass flow sensor, self-cleaning operation Engine must run at speed exceeding 2000 min ⁻¹ and the engine temperature be greater than +60° C. Then, ignition "OFF" - voltage reading after approx. 4s.	2...5 V Reading duration approx. 1s.



TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Fuel delivery at return:	at least 700 cm ³ /30 s
* Supply voltage under load:	at least 12 V
* Fuel delivery from pre-supply pump	at least 800 cm ³ /30 s
Pressure regulator	
* Fuel pressure with engine at standstill:	2,8...3,2 bar
at idle:	approx. 0.5 bar lower
at 0.5 bar charge-air pressure:	approx. 0.5 bar higher
Fuel system, leakage	
* Fuel pressure after 20 mins. with engine at standstill	at least 1.0 bar
Idle actuator	
* Resistance value at +15...+30°C between term. 2 and term. 3:	17...22,5 Ω
term. 2 and term. 1:	19...25,0 Ω
Hot-wire air-mass flow sensor	
* Resistance value between term. 6 and term. 3:	0...1100 Ω
term. 5 and term. 3:	3.6...4.1 Ω
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature +15...+30°C:	1.45...3.3 k Ω
with engine at norm. op. temp. approx. +80°C :	280...360 Ω

TEST SPECIFICATIONS (Continued)

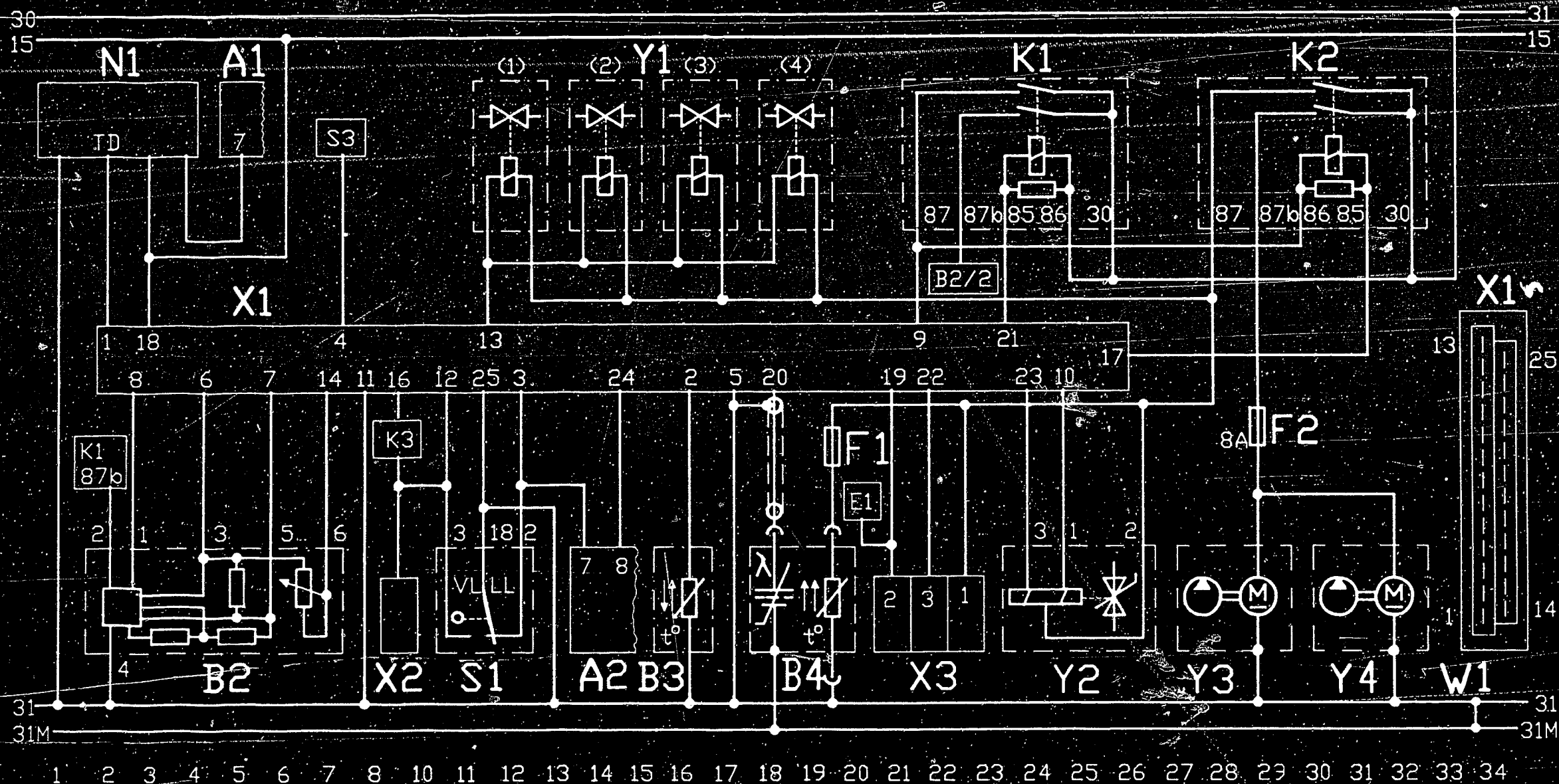
Component/function	Set values
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature +15...+30°C:	14.5...17.0 Ω
* Leakage after 60 s:	No drop must fall
Start control	
* Voltage at injection valve on start initiation:	greater than 1.5 V
after approx. 15s:	approx. 0.5 V
Idle adjustment	
Eng. at norm. op. temp., approx. +80°C	
* Idle speed:	800...950 min ⁻¹
with on/off ratio:	31...33 %
* Basic engine speed (test pin to ground):	725...775 min ⁻¹
CO adjustment	Not applicable due to lambda closed-loop control
Integrator voltage	
* Closed-loop control (sensor connected must be hot)	
Reading fluctuates between:	0...13 V
* Open-loop control (disconnect sensor lead):	10...13 V
* Rich value (sensor lead disconnected and applied to ground at control-unit side):	10...13 V
* Lean value (apply 2 V to the sensor lead on control-unit side):	less than approx. 0.5 V

TEST SPECIFICATIONS (Continued)

Component/function	Set values
CO adjustment (on model without lambda closed-loop control)	
* At idle speed:	0,9...1,6 % by vol.
* With simulated full-load enrichment (jump term. 3 and term. 18 at throttle- valve switch):	4,0...6,0 % by vol.
Lambda sensor heating	
* Internal electrical resistance (PTC) with engine at standstill:	1...15 Ω

See equipment and Autodata microcards
for setting values for valve clearance and
other engine-related data.

For production reasons:
continued on the following
coordinate.



280/1429

A1 = Ignition trigger box
 A2 = Ignition control unit
 B2 = Hot-wire air-mass flow sensor
 B3 = Temperature sensor (engine)
 B4 = Heated lambda sensor
 E1 = Limp-home indicator
 F1 = Fuse (sensor heater)
 F2 = Fuse (fuel pump)
 K1 = Main relay

K2 = Pump relay
 K3 = Auxiliary cooling-fan relay (with air conditioner)
 N1 = TD amplifier
 S1 = Throttle-valve switch
 S3 = Drive switch (automatic)
 W1 = Ground strap (engine)
 X1 = Control-unit plug
 X2 = Test pin (low-idle-speed control)

X3 = Test connection
 1 Positive voltage, injection valve
 2 Limp-home indicator
 3 Integrator voltage
 Y1 = Solenoid-operated injection valve
 Y2 = Idle actuator
 Y3 = In-tank fuel pump
 Y4 = In-tank pre-supply pump

ELECTRICAL TERMINAL DIAGRAM (lambda sensor installed only in vehicle with control unit 0 280 000 532)

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

* LH-Jetronic control unit (upper illustration, Item 1)

The control unit is located on the left behind the engine firewall beneath a cover.

For connecting the universal test adapter, remove control unit and disconnect control-unit plug. To do this, press open latch (locking tongue).

* Fuel-pump fuse (center illustration, No. 14).

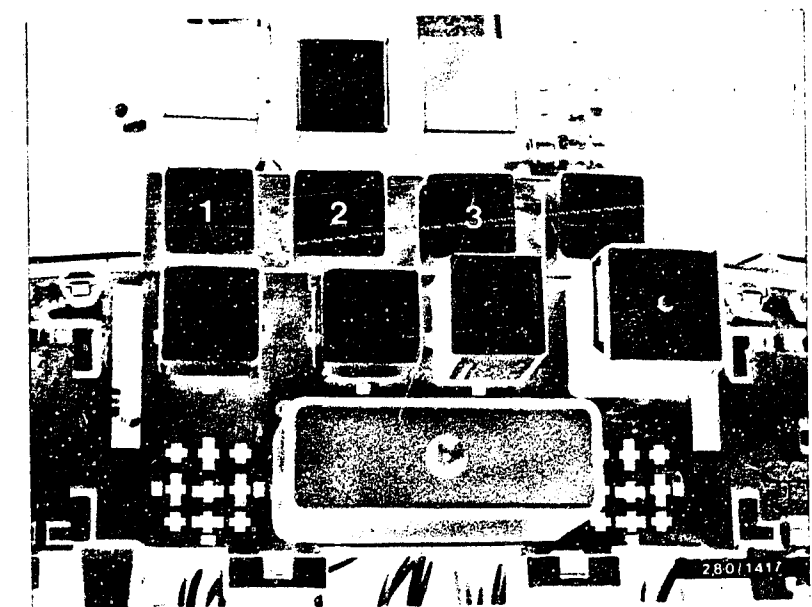
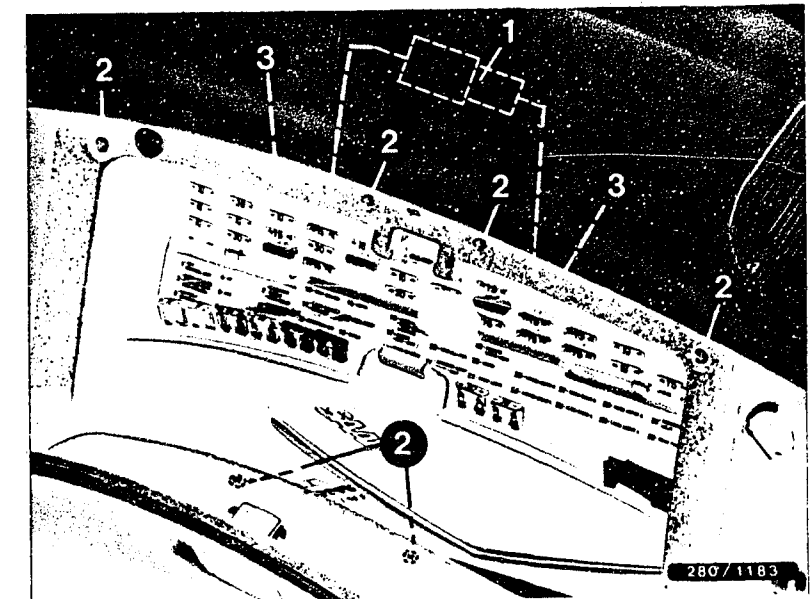
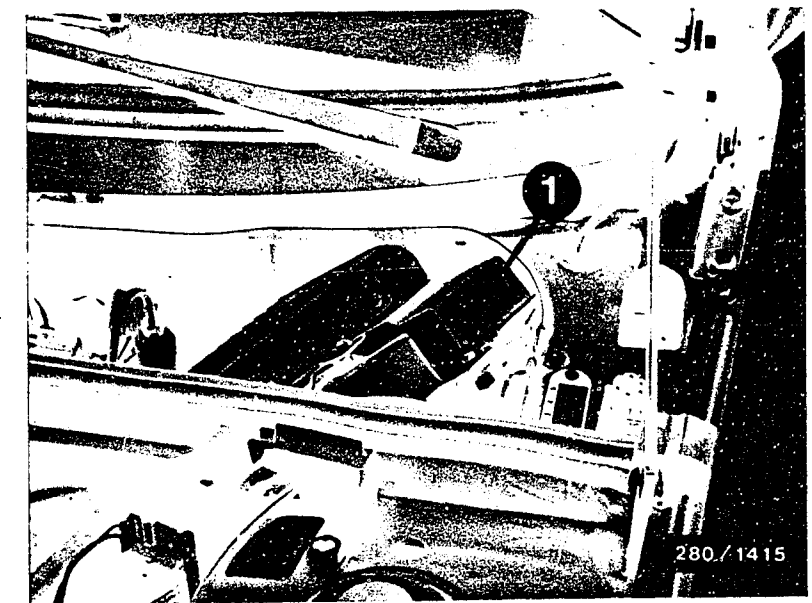
* Safety circuit (switch on electric fuel pump for measurement), center illustration.

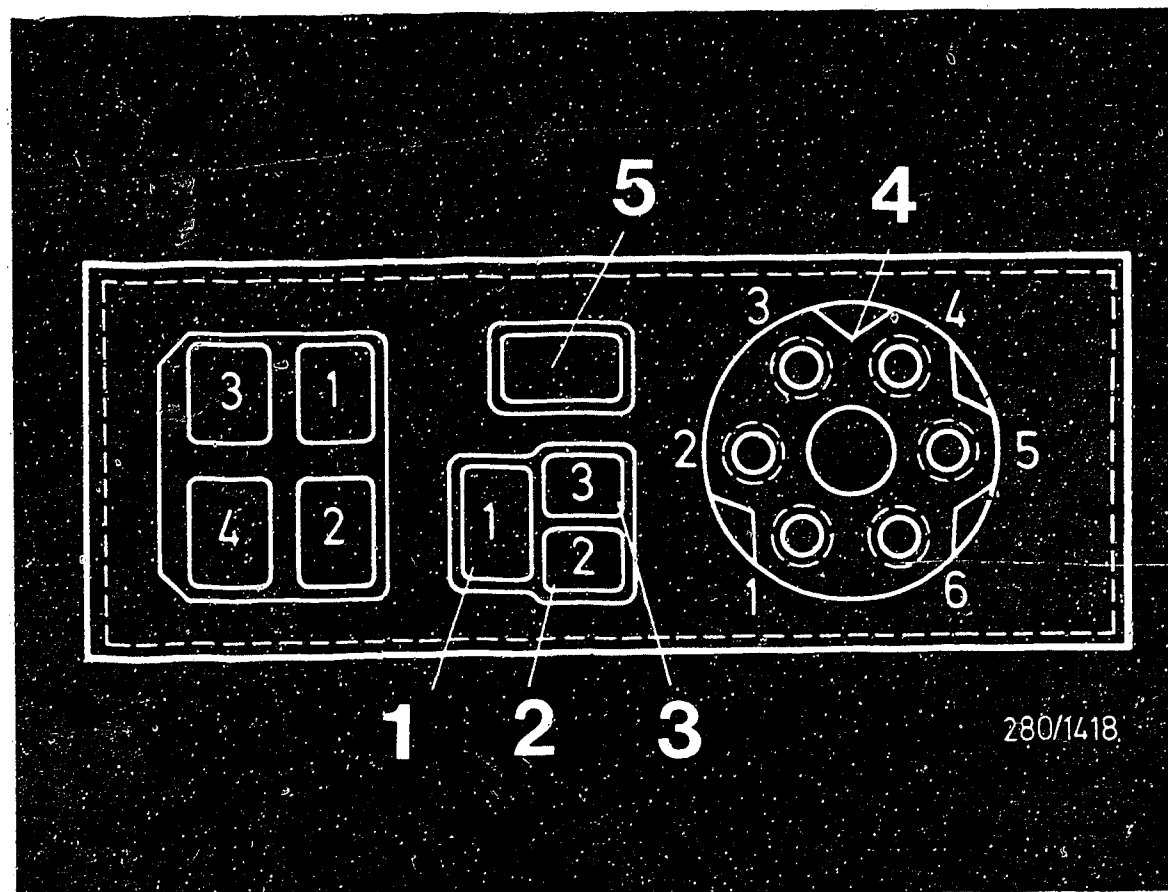
Open glove compartment and remove cover above fuse box. Pull out fuses Nos. 14 and 22 and insert auxiliary lead (Item 1) with 8 A fuse element.

* Main and pump relays and TD amplifier (lower illustration).

Remove glove compartment. To do this, loosen 4 screws at top and 2 screws at bottom (center illustration, Item 2). Unlatch right-hand vent grille. Remove fuse box. Loosen screws (center illustration, Item 3). Pivot relay plate downwards.

Lower illustration:: 1 = Main relay
2 = Pump relay
3 = TD amplifier

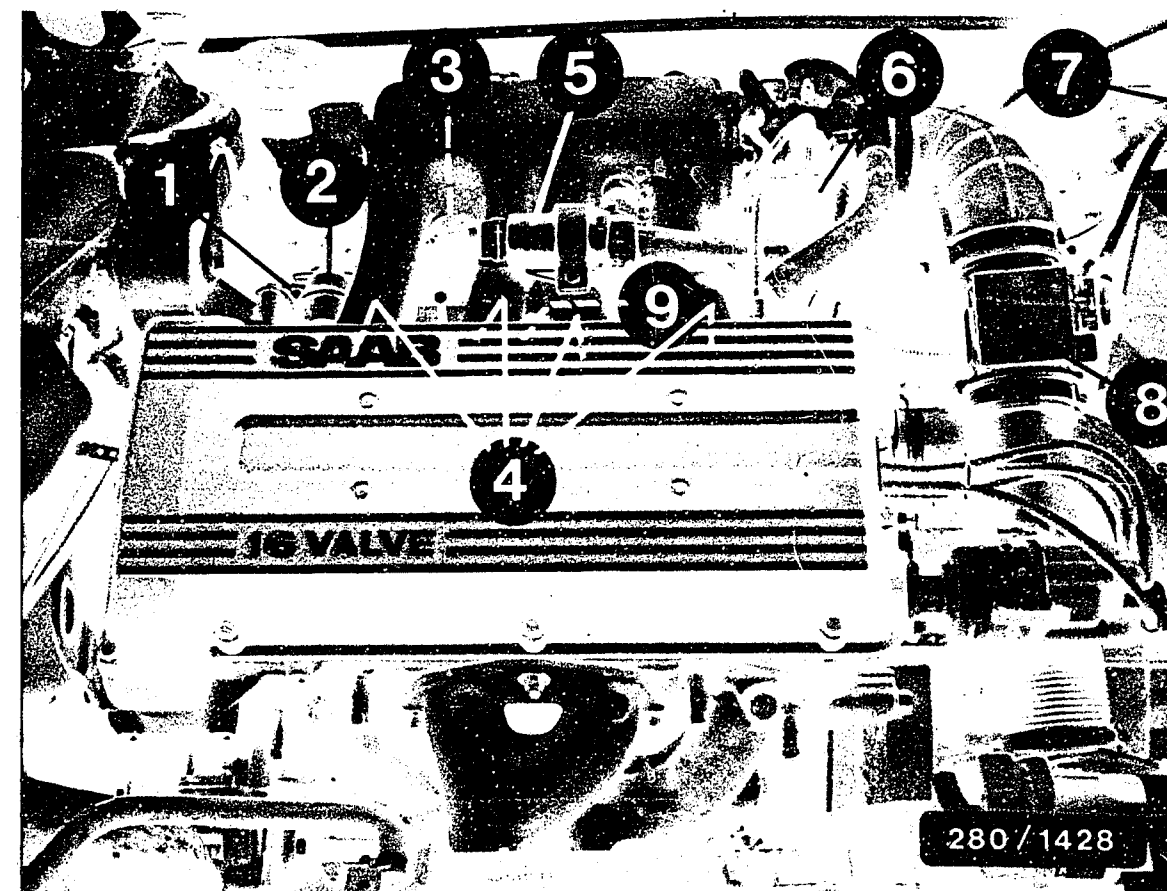




- 1 = Positive voltage from pump relay
- 2 = Limp-home indicator
- 3 = Integrator voltage (■)
- 4 = TSI socket
- 5 = Test pin (low-idle-speed control)

TEST CONNECTION

The connection point for the ignition-point check (TSI socket), as well as for the LH system are located together in one common test connection which is positioned in the engine compartment on the left-hand side behind the engine firewall.



- 1 = Ground terminals
- 2 = Pressure regulator
- 3 = Temperature sensor (engine)
- 4 = Solenoid-operated injection valves
- 5 = Idle actuator
- 6 = Throttle-valve switch
- 7 = Fuel filter
- 8 = Hot-wire air-mass flow sensor
- 9 = Knock sensor

Components on the engine

Upper illustration

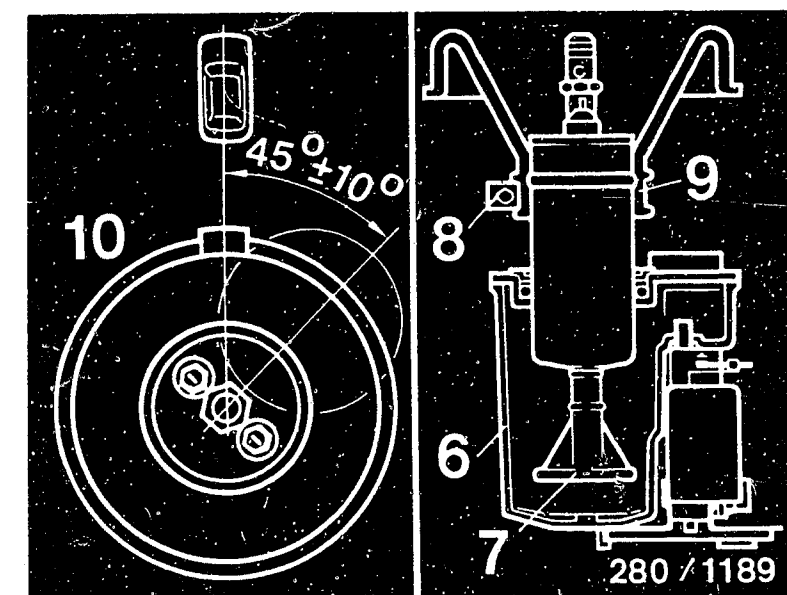
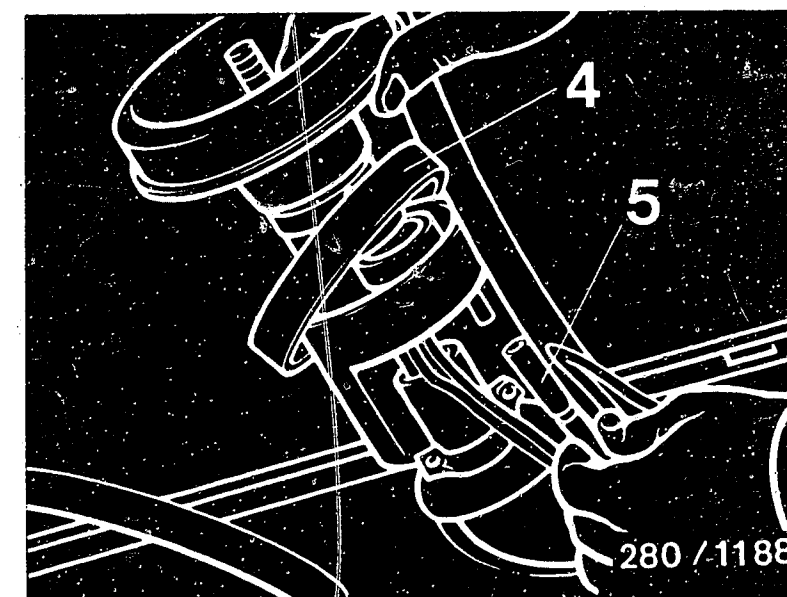
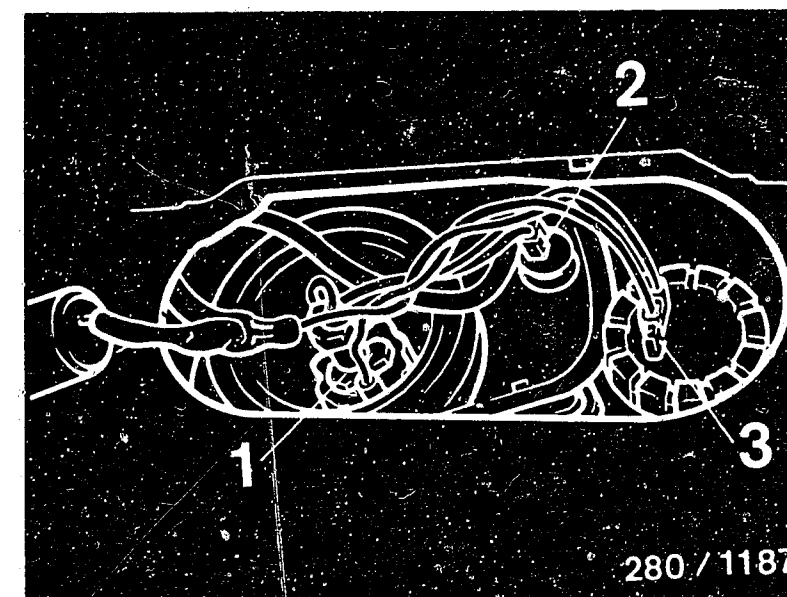
- 1 = In-tank electric fuel pump
- 2 = Electrical connection, in-tank pre-supply pump
- 3 = Electrical connection, fuel-level sensor

Removing the in-tank electric fuel pump

- Disconnect battery.
- Fold up rear part of the luggage-compartment floor, unscrew both fastening screws and remove the floor.
- Turn both bayonet sockets, lift up the flap and push back slightly.
- Loosen electrical connections from electric fuel pump, pre-supply pump and fuel-level sensor.
- Pinch off fuel-injection line with hose clammer.
- Unscrew inlet-union screw from the pressure connection of the electric fuel pump and pull off ring connection with fuel-injection line. Attention! Fuel may escape. Take necessary safety measures.
- Remove clamp (8) from sealing collar (9) of the electric fuel pump.
- Pull up electric fuel pump together with tank, disconnect fuel return hose from tank (5), loosen line of pre-supply pump from tank lead-through.
- Pull electric fuel pump out of tank (6) and remove strainer (7).
- Unscrew clamp (8) from sealing column (9) and pull electric fuel pump out of the collar.

Installing

- Mount sealing collar in such a way that its edge lies 50 mm above the upper edge of the fuel pump.
- Secure suction strainer (7), insert fuel pump into tank (6), position new O-ring.
- Install fuel pump in such a way that the overpressure valve of the fuel pump is offset by 45° in relation to the sealing-collar mark (10).
- Adjust overall height of the fuel pump to 250 mm.
- Proceed further in reverse sequence of steps as described under "Removing the in-tank electric fuel pump".



Further installation positions

- * Grounding points for injection system
On the engine block at the rear on the right-hand side, beneath the pressure regulator.
- * Grounding point for in-tank electric fuel pump and in-tank pre-supply pump beneath the left-hand side of the rear seat bench.
- * Lambda sensor in the exhaust pipe upstream of the catalytic converter.
Plug-in connection for sensor signal and heater beneath the intake manifold.
Fuse for sensor heater in the form of a cable fuse near to the windshield-wiper motor.
- * Knock control (APC system)
Switchgear beneath instrument panel, near to the charge-air-pressure sensing switch.
Knock sensor on engine, beneath the intake manifold.
Solenoid-operated valve on fan housing.
Pressure sensor next to switchgear.
Vacuum switch next to switchgear.

For production reasons:
continued on the following
coordinate.

BOSCH system : ABS
Vehicle make : BMW
Basic microcard : PKW-066

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SPECIAL FEATURES

This microcard contains the trouble-shooting instructions for the following models valid at the time of printing:

BMW 325 iX, (four-wheel drive)
11.1987 -> 01.1987

- * ABS with 4 wheel-speed sensors and 3 hydraulic channels.
- * Acceleration sensor (a_L)
- * Signal from clutch switch
- * Idle-speed increase

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- * For reasons of safety, the hydraulic modulator must not be repaired, but be exchanged only as a complete unit.
Exception: relays.
- * Do not loosen any screws on the hydraulic modulator!
There would then be danger of fatal accident caused by failure of the brakes.
- * Caution when handling brake fluid.
Poisonous!
- * Only a limited brake test is permitted; no power-output test is permitted.

For further information, see brief instructions.

TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- * Regulatory tire size fitted?
- * Check for firm seating of ground of return-supply pump.
- * Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- * Check for firm seating of ground strap between engine block and vehicle frame.
- * Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- * If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- * If the ABS warning lamp lights up constantly and does not go out, check the following points:
 - Controller plug sitting correctly on controller and latched?
 - All plug contacts O.K.?
 - Spring contacts latched?
 - Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed sensor leads at controller plug for correct assignment:

Wheel-speed sensors:

Front left - term. 22 and term. 4.
Front right - term. 11 and term. 21.
Rear left - term. 8 and term. 9.
Rear right - term. 24 and term. 26.

- V-belt torn?
(Alternator does not supply voltage, charging and ABS warning lamp light up).
- * Connect ABS—LED tester to ABS wiring harness.
- Only detach and connect controller with ignition off.
- For test purposes, switch on ignition in all program switch settings (tester runs on power supplied by vehicle battery).
- Observe LED (green) for power supply in all program switch settings.

I M P O R T A N T !

Do not drive with the tester connected!
The entire test program is to be repeated whenever repairs have been carried out.
The ABS system is a vehicle safety system.
Work on this system require detailed knowledge of the system.
The conventional brake system must be working properly.

General trouble-shooting information:

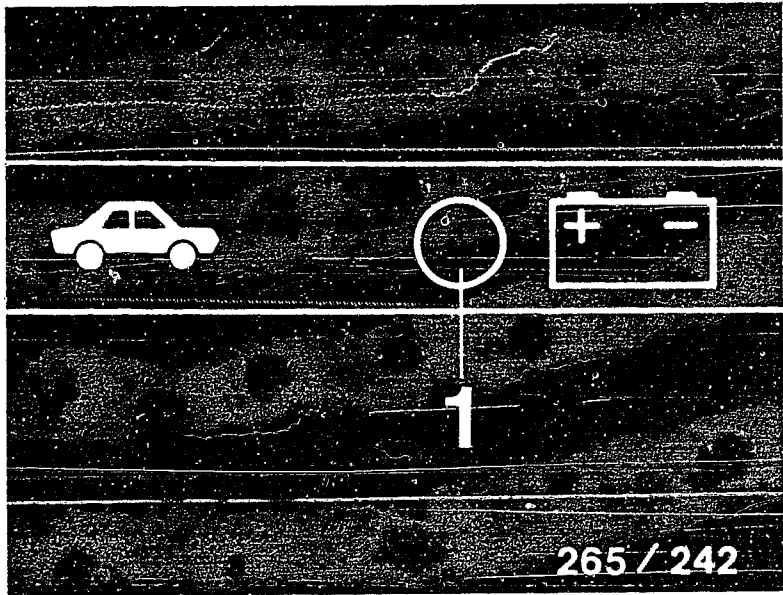
Check all leads for short-circuit to ground and contact with positive leads, as well as for rubbing and pinching.

RAPID DIAGNOSIS CHART

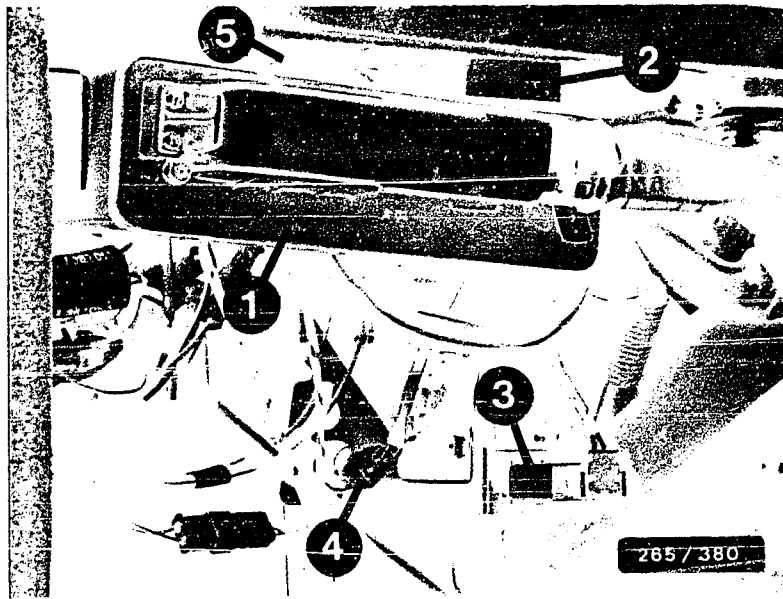
Do not drive with tester connected. Are all test conditions met?

Program-switch positions 1 to 6

Testing of (measurement at terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of faults
Power supply (term.1 und term.20)	Ignition on	LED 1 (top picture) continuously lit	<div>*Battery insufficiently charged</div> <div>*High voltage drops</div> <div>*Overvoltage-protection relay defective</div> <div>*Check lead to driving switch term.15</div>



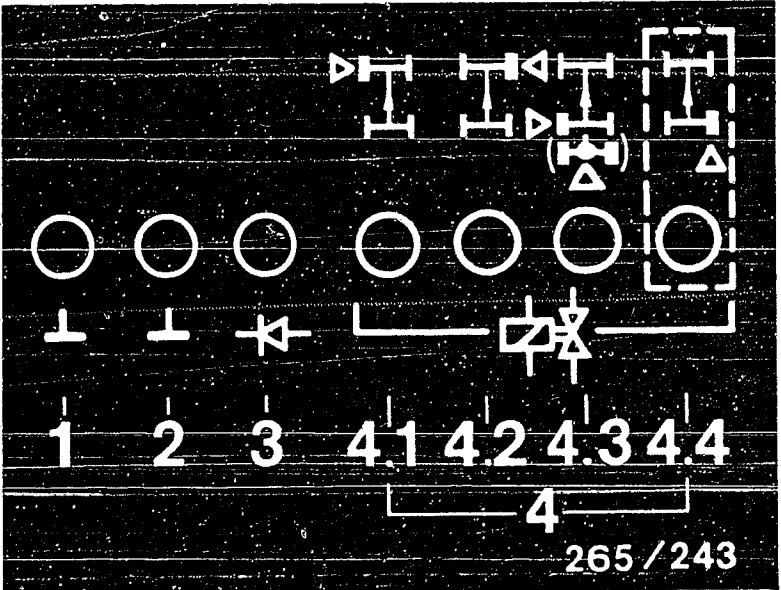
- 1 = Controller
- 2 = Overvoltage-protection relay
- 3 = Stop-lamp switch
- 4 = Clutch switch
- 5 = Ground terminal



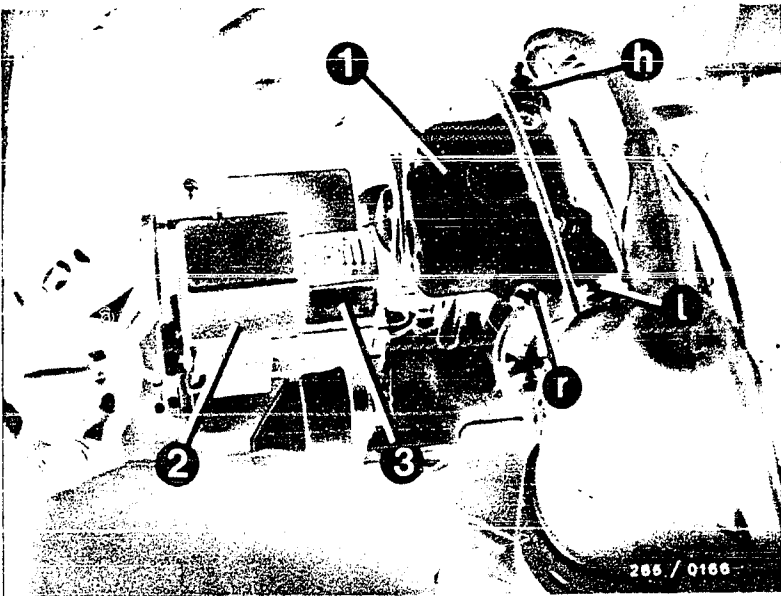
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.—, term.35) Off-position and ground connection of relay ABS warning lamp	Ignition on	6 LED (1 to 4.3) simultaneously brightly lit (top picture) ABS warning lamp in vehicle must light up	<ul style="list-style-type: none">* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit.* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.Solenoid-operated valve internal resistance 0,7...1,7 Ω* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.



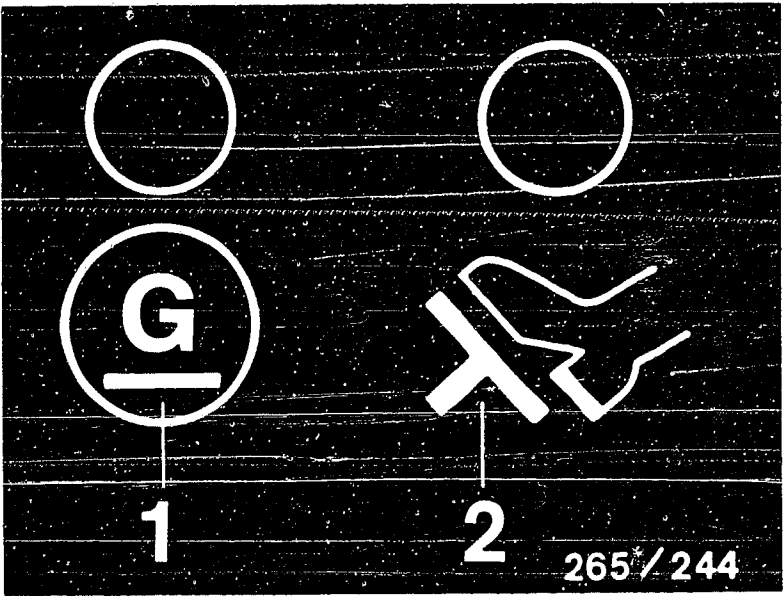
1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 2

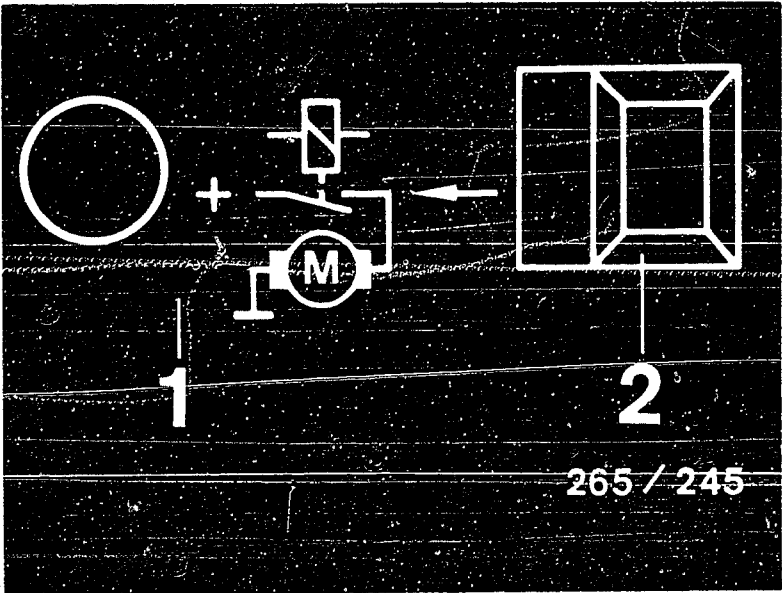
Testing of (Measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Alternator voltage from term.61 (term.15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Check lead to alternator term.61 * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective. * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.



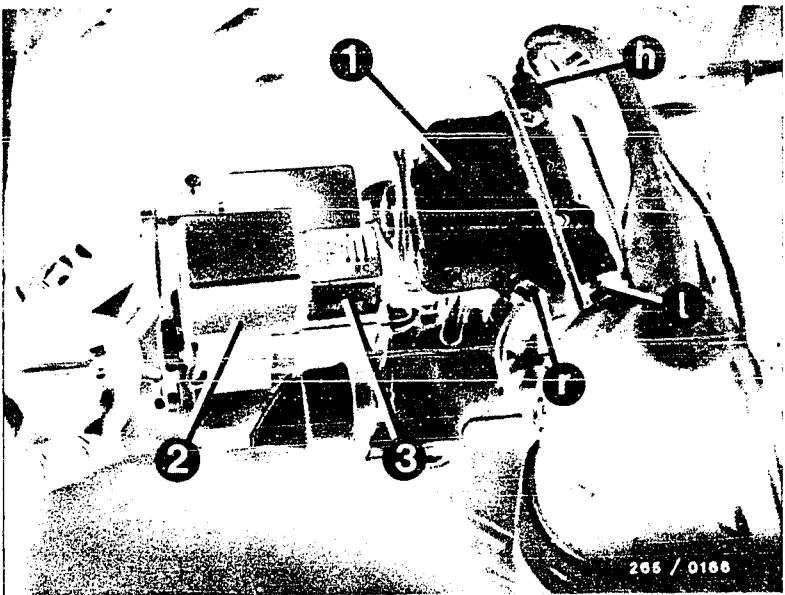
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 3

Testing of (measurement at terminals)	Additional operation	Test specifi- cations (reading)	Possible causes of faults
Motor relay, Pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, Press button 2 continuously (top picture)	LED 1 lit, pump motor running. After button is released, LED continues to light due to running-on of motor (top picture).	<ul style="list-style-type: none">* Motor relay defective* Check ground connection and positive terminal of hydraulic modulator* Check leads from controller term.14 and term.28 to hydraulic modulator term.9 and term. 11.* Pump motor defective



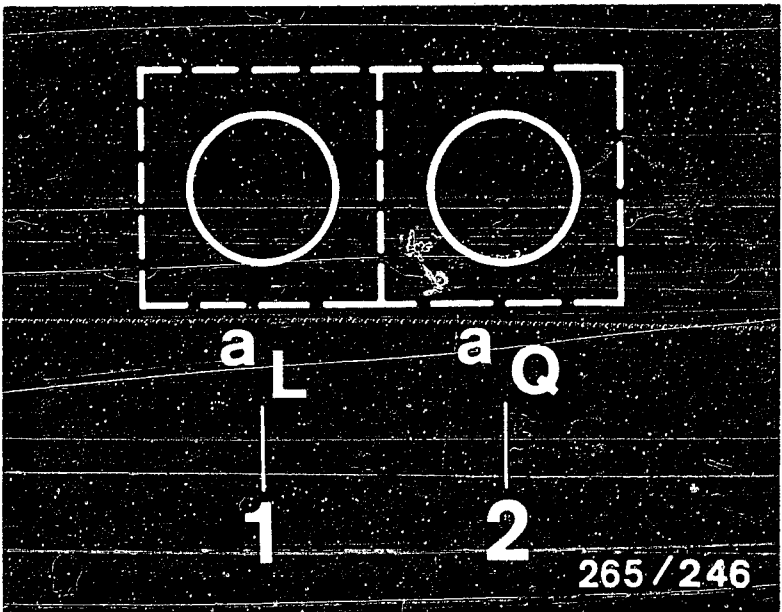
1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay



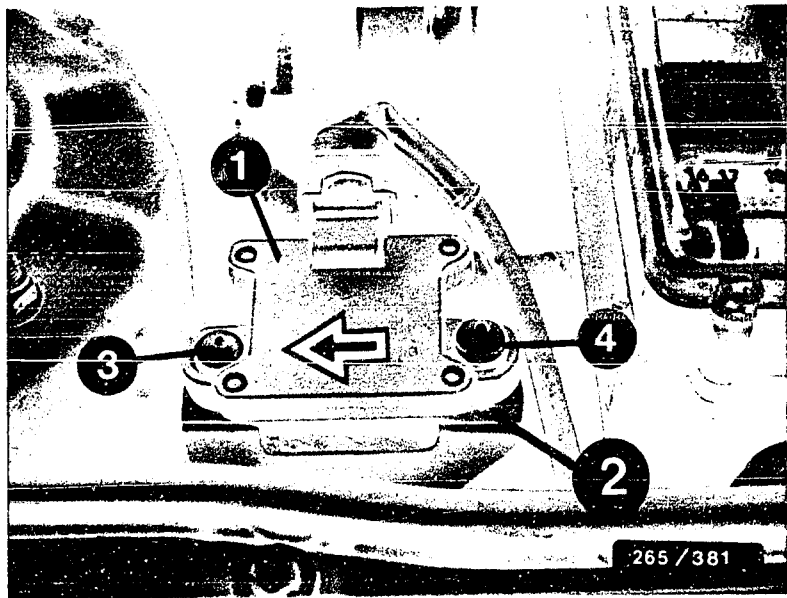
RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 4

Under test (measurement at the terminals)	Addition- al operation	Test specification (reading)	Possible causes of trouble
Acceleration sensor a L (term.16)	Ignition on	LED a L lights up	<ul style="list-style-type: none">* Check acceleration sensor: resistance value: <100 Ω Exchange sensor: drill out shear-head screw. Adjust sensor with special tool Pay attention to installation position. Use new shear-head screws.* Check lead from acceleration sensor to ABS controller term.16.* Check lead from controller term.1 to acceleration sensor.

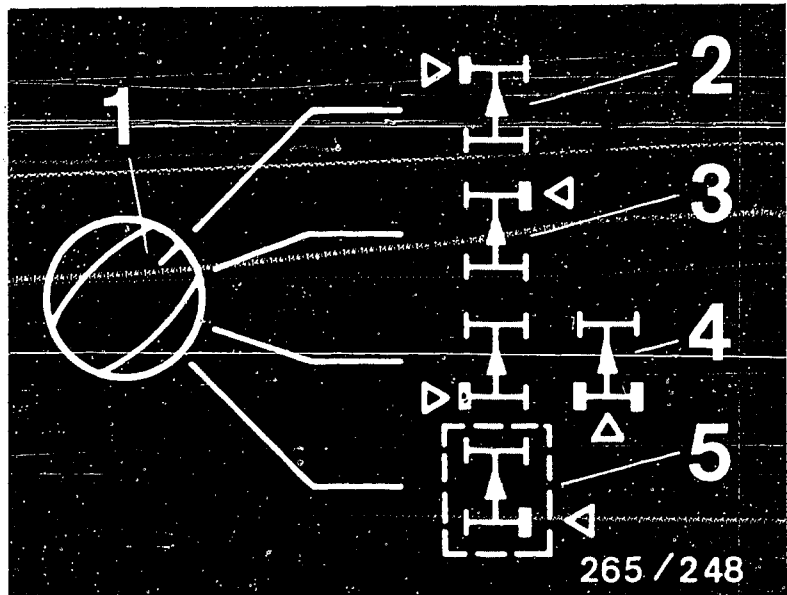
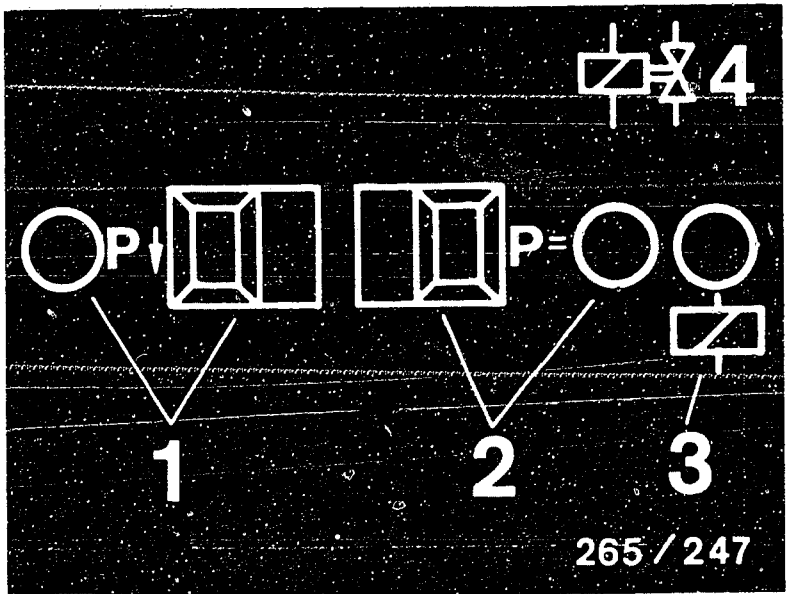


- 1 = Acceleration sensor
- 2 = Chock
- 3 = Shear-head screw, front
- 4 = Shear-head screw, rear
- Arrow = Forward direction of travel



RAPID DIAGNOSIS CHART (CONTINUED)
Program-selector-switch position 5 (3-channel hydraulic modulator)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	* Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running * Valve relay (make contact) defective * Break in line from valve relay term. 87 to batt. +ve * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push-button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correctly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.— Wheel, rear right: term.— Rear axle: term.18 * Hydraulic modulator defective
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		

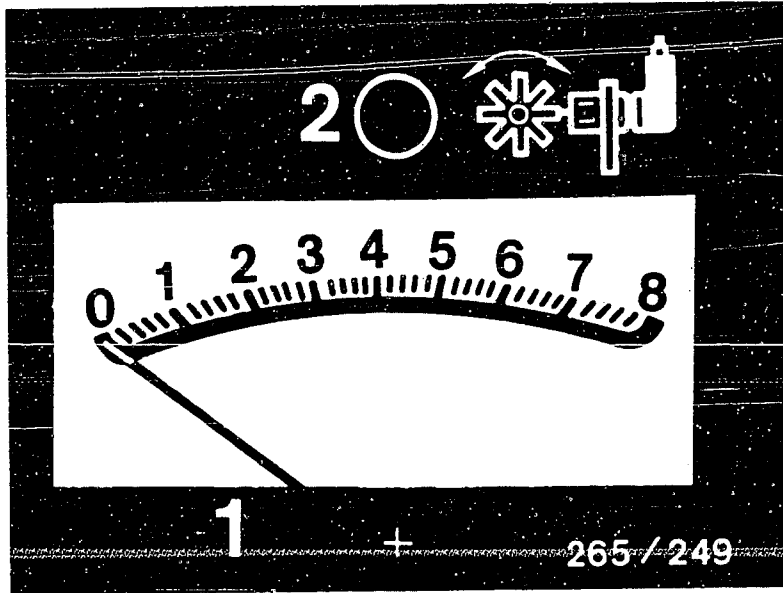
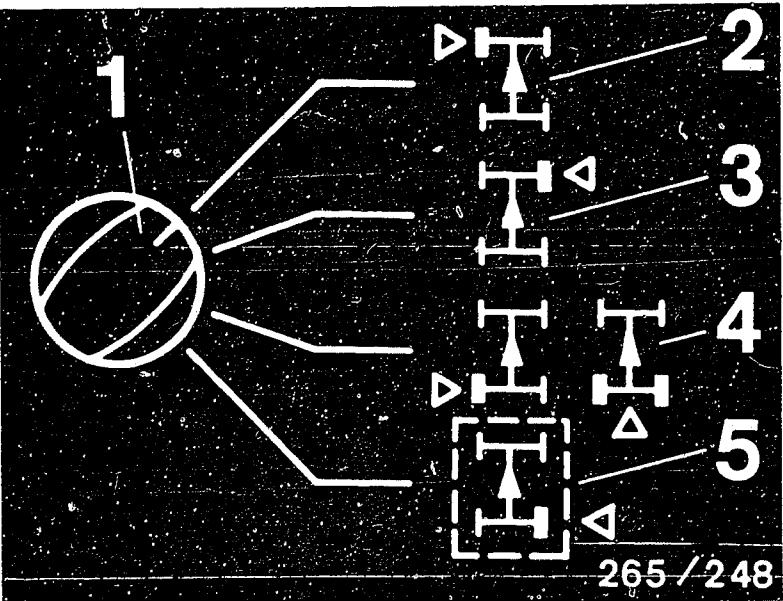


RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.4 and term.0,6...1,6 Wheel, front right: term.11 and term.21 Wheel, rear left: term.8 and term.9 Wheel, rear right: term.24 and term.26)</p>	<p>Chock up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turnable by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1.Smallest reading larger 1,6 divisions</p> <p>2.Permissible fluctu- ation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Break in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective Winding resistance Front axle: 0,6...1,6 k Ω Rear axle: 22 k Ω</p> <p>*Air gap between wheel-speed sensor and ring gear too wide</p> <p>*Ring gear defective or loose</p> <p>*Ring gear with incorrect number of teeth Front axle: 48 teeth Rear axle: 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Reading appears, LED 2 does not light up: loose contact in wheel- speed-sensor lead.</p>

Continue test with next coordinate.



Check idle-speed increase.

1. Throttle-valve positioner:

*Ignition off and on: Idle stop of actuator extended. If not, actuator defective.

*Operate engine at idle speed:

Idle stop of actuator retracted.

If not, idle speed far too high. Check vacuum energization of actuator:

*Check hoses for leaks and correct assignment.

*Disconnect hose from throttle-valve positioner and apply vacuum to actuator with vacuum pump.

Stop must retract. If not, actuator defective. If yes, check solenoid-operated valve.

*Adjust idle-speed increase:

Disconnect hose from actuator. With engine running, idle speed increases to 2400+ 100 min⁻¹. If not, adjust engine speed at adjusting screw on actuator.

2. Solenoid-operated valve:

*Disconnect plug from solenoid-operated valve and apply battery voltage to valve.

With engine running, idle stop of actuator must extend and engine speed must rise.

If not, solenoid-operated valve defective.

If yes, check leads to solenoid-operated valve.

*Ignition off. Check for open circuit and short circuit in leads from solenoid-operated valve to controller plug term.3 and to ground.

3. Clutch switch:

*Ignition off. Disconnect controller plug.

Connect voltmeter to term.33 (+) and ground.

Ignition on and press brake pedal:

Voltage must be greater than 10 V.

Depress clutch: Voltage 0 V.

If not correct, check switch and leads; adjust switch.

Final check: Road test for at least 20 seconds at above 30 km/h, and drive for at least 3 seconds at at least 50 km/h. Warning lamp must not come on.

TEST SPECIFICATIONS

Wheel-speed sensors

* Winding resistance at ambient temperature (-10°C...+120°C) for

Front axle:

600...1600 Ω

Rear axle:

600...1600 Ω

Hydraulic-modulator solenoid-operated valves

* Winding resistance at ambient temperature

(-10°C...+120°C):

0,7...1,7 Ω

Air gap:

0,8 ± 0,5 mm

Tightening torque for

* Wheel-speed sensor fastening screws:

> 8 Nm

* Brake-line connections on hydraulic modulator:

12...16 Nm

Number of teeth

* Front axle:

48 teeth

* Rear axle:

48 teeth

Acceleration sensor

* Contacts closed when in horizontal position:

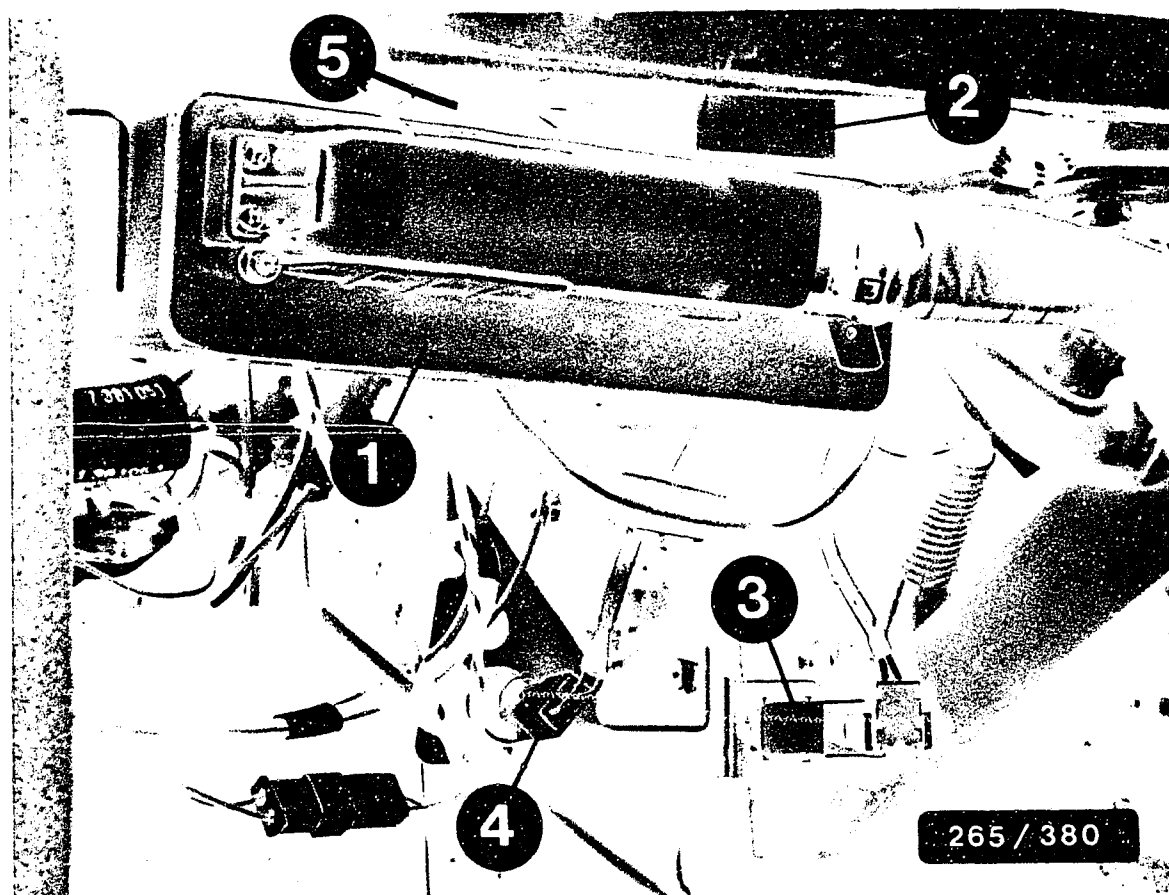
< 100 Ω

Solenoid-operated valve for idle-speed increase

* Winding resistance at

ambient temperature (+15°C...+30°C):

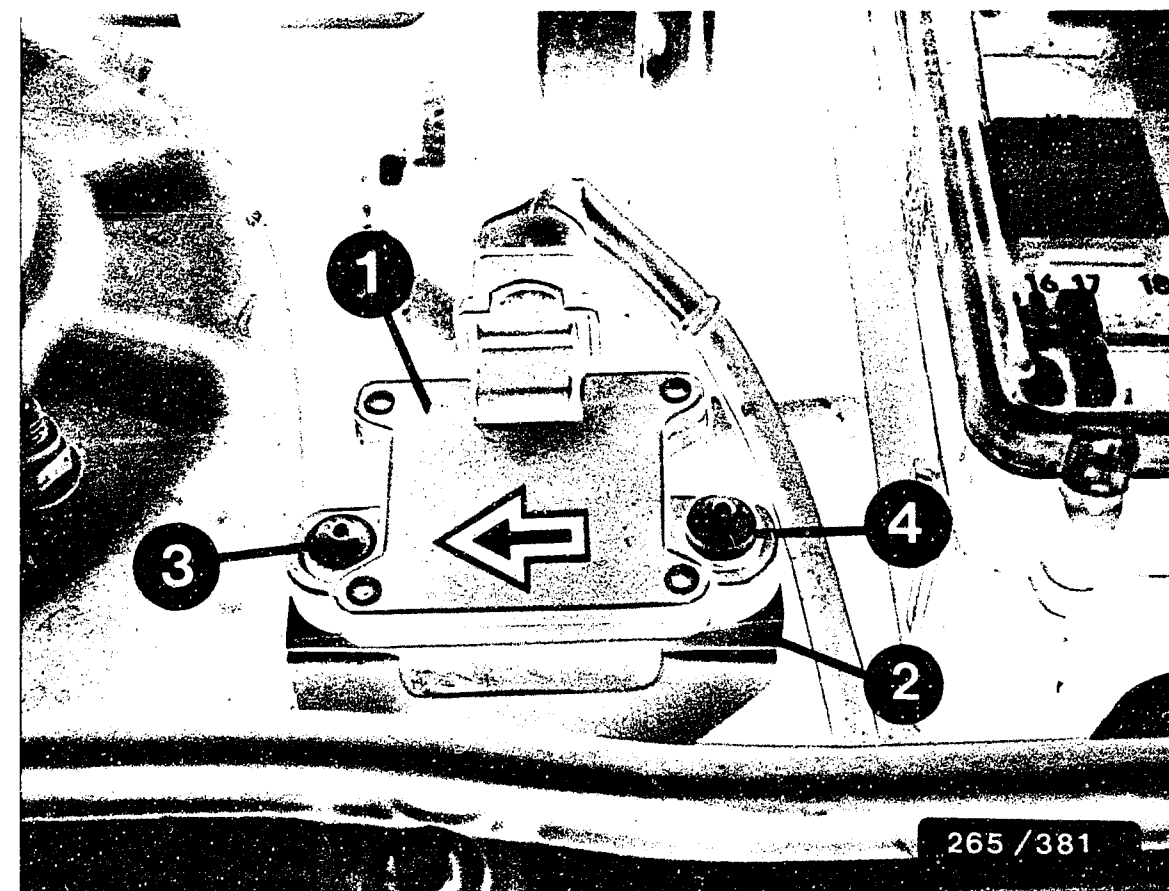
18...45 Ω



INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

- * Controller (Item. 1):
to the left of the steering column behind the footwell panelling.
- * Overvoltage-protection relay (Item 2):
on the right above the controller.
- * Stop-lamp switch (Item. 3):
on the brake pedal.
- * Clutch switch (Item 4):
on the clutch pedal.
- * Ground terminal (Item 5) for ABS:
behind the controller.
- * ABS warning lamp: in the instrument panel.
- * Battery: in the luggage compartment on the right.

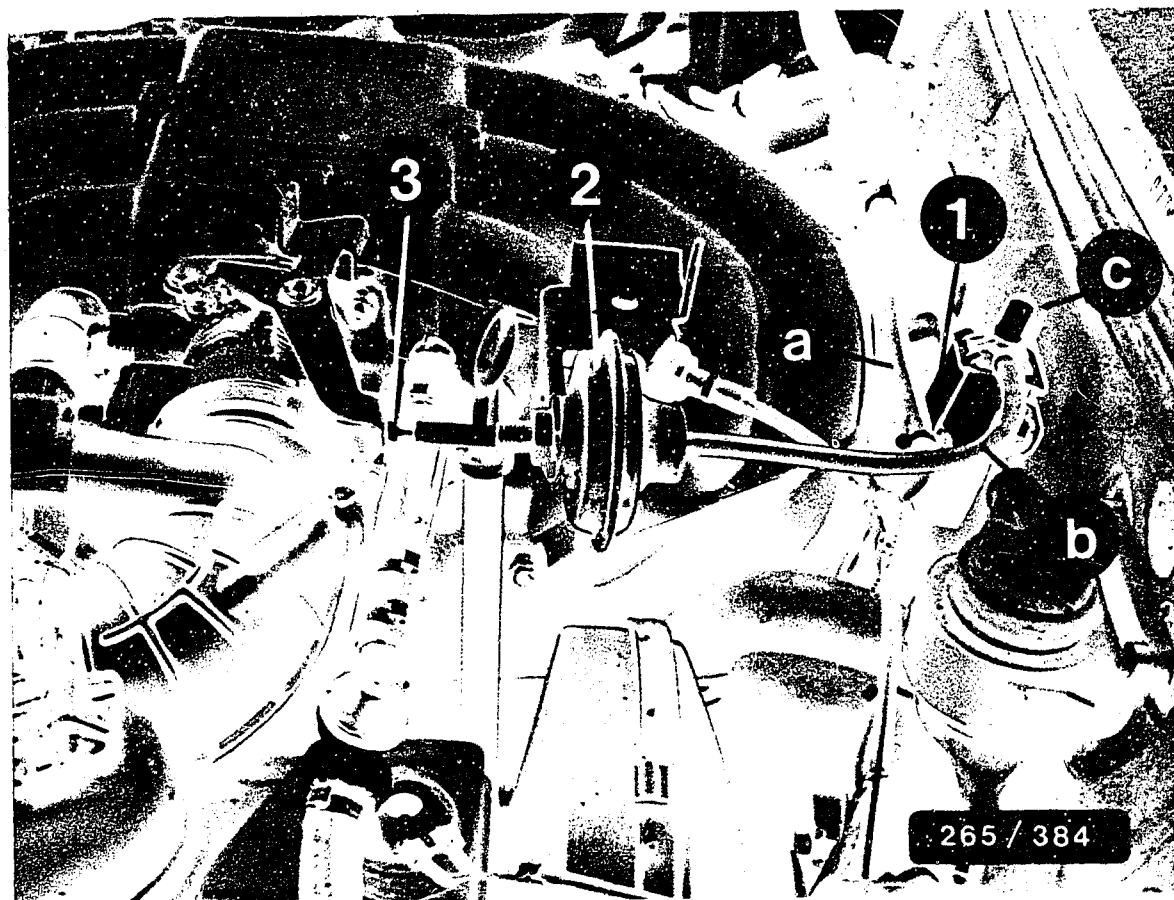


- 1 = Acceleration sensor
- 2 = Chock
- 3 = Shear-head screw, front
- 4 = Shear-head screw, rear
- Arrow = Forward direction of travel

INSTALLATION POSITION OF COMPONENTS (Continued)

Exchange accelerator sensor:
drill out shear-head screws. Adjust sensor using special tool. Pay attention to direction of installation. Use new shear-head screws.

- * Wheel-speed sensors, front axle:
left and right in the steering knuckles.
Do not mix up the left-hand and the right-hand wheel-speed sensors when installing.
- * Wheel-speed sensors, rear axle:
left and right near to the brake calipers.
- * Ground cables for pump motor and valve relay (->8.87):
in the engine compartment on the left-hand side on the bodywork.



- 1 = Solenoid-operated valve
- a = Vacuum line to intake manifold
- b = Vacuum line to actuator
- c = Vent to atmosphere
- 2 = Throttle-valve positioner
- 3 = Adjusting screw

INSTALLATION POSITION OF COMPONENTS (continued)

Adjusting the throttle-valve positioner:

Operate engine at idle speed and disconnect vacuum hose from actuator. Idle speed must increase to $2400 \pm 100 \text{ min}^{-1}$. Engine speed can be corrected with throttle-valve positioner adjusting screw.

- * Hydraulic modulator:
In engine compartment behind left-hand headlamp.
The hydraulic modulator must not be repaired, but must be replaced only as a complete unit.
Exception: Replacement of relays.

For production reasons:
continued on the following
coordinate.

Brief instructions : OPE-5006
BOSCH system : EI
Vehicle make : OPEL Omega-A
Basic microcard : Pass. car 071

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Notes on removal and installation.....	23

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Opel model: Opel Omega-A, with 1.8 l/ 4-cyl. engine 9.86 ->.

- * EI control unit 18 NV engine (carburetor)
0 227 400 040,..041
- * EI control unit 18 SV engine (carburetor)
0 227 400 028
- * EI control unit 18 SEH engine (LE-Jetronic)
0 227 400 030
- * Ignition coil with trigger box (with current limitation).
0 221 600 053
- * Octane-number adaptation

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to various causes/ component faults.
For a detailed description of trouble-shooting refer to the instructions in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to prevent damage to the engine, trigger boxes, control units or ignition system, be sure to observe the directions in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

For the compression test, detach trigger-box plug or connect ignition coil term. 4 firmly to ground with auxiliary cable.

Note: Auxiliary cable must have at least 2 k Ω interference suppression.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptom)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)										
*			*							High-voltage side
*										Ignition sequence
*			*							Ignition coil
*										Voltage, EI control unit
*										Voltage, trigger box
*										Insulation, pulse generator
*										Internal resistance, pulse generator

TROUBLE-SHOOTING CHART (Continued)

Customer complaint (fault symptom)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)										
*										Voltage, pulse generator
*										EI control-unit operation
*										Primary signal
*										Contact resistance
*										Engine-speed signal (LE-Jetronic)
	*		*	*	*					Pressure-sensor operation (carburetor)

TROUBLE-SHOOTING CHART (Continued)

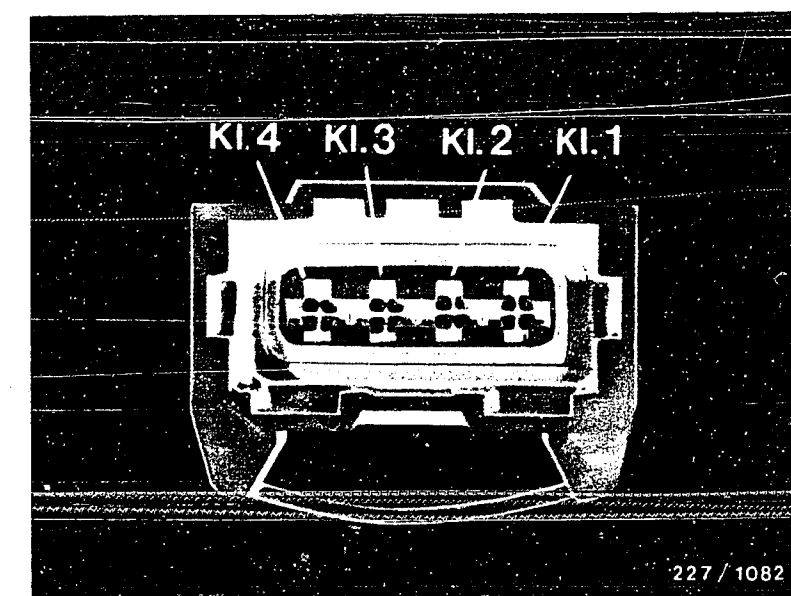
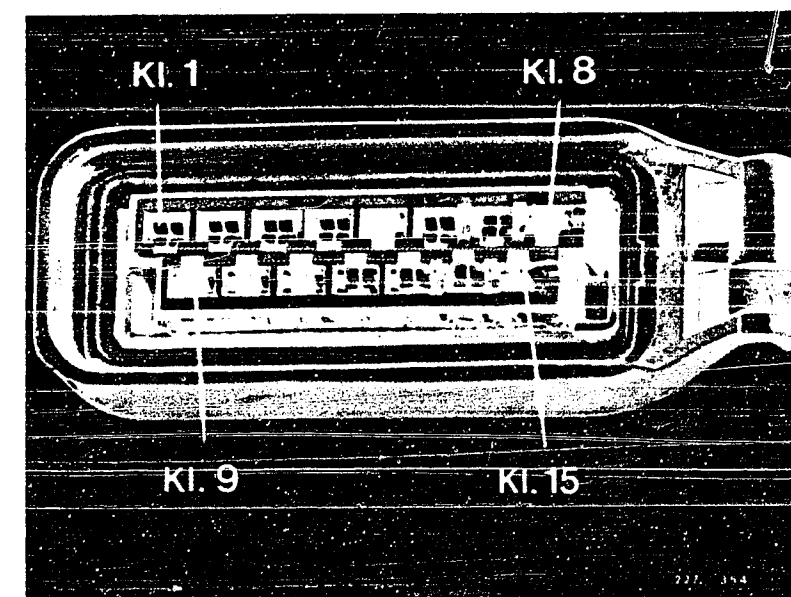
Customer complaint (fault symptom)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)										
		*	*	*	*					Pressure sensor, leakage (carburetor)
		*	*	*	*					Throttle-valve switch, idle (LE-Jetronic)
	*	*			*					Throttle-valve switch, full load (LE-Jetronic)
							*			Temperature sensor, engine
		*		*		*				Load signal (LE-Jetronic)
			*							Voltage, ignition coil
				*	*	*				Octane-number adaptation

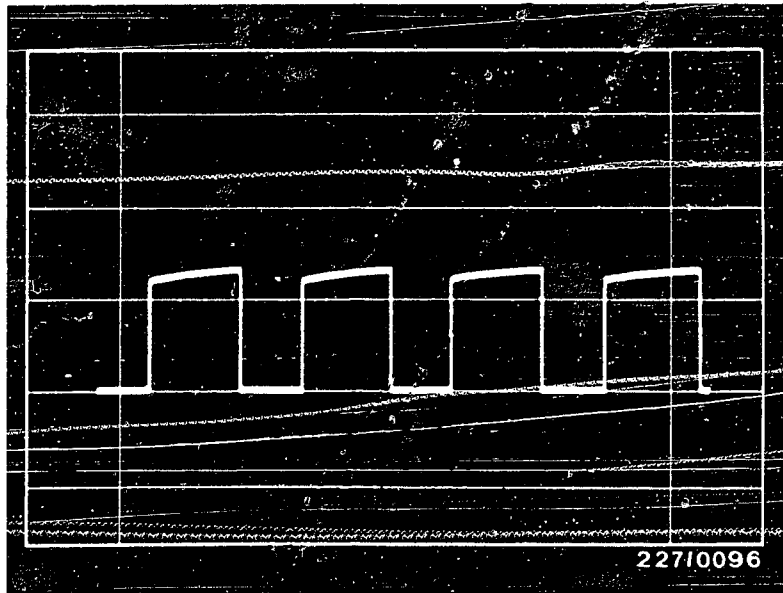
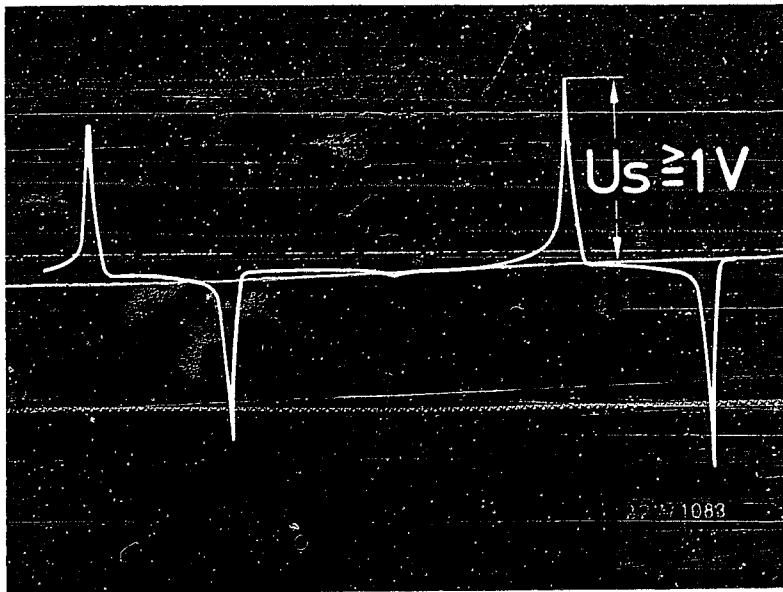
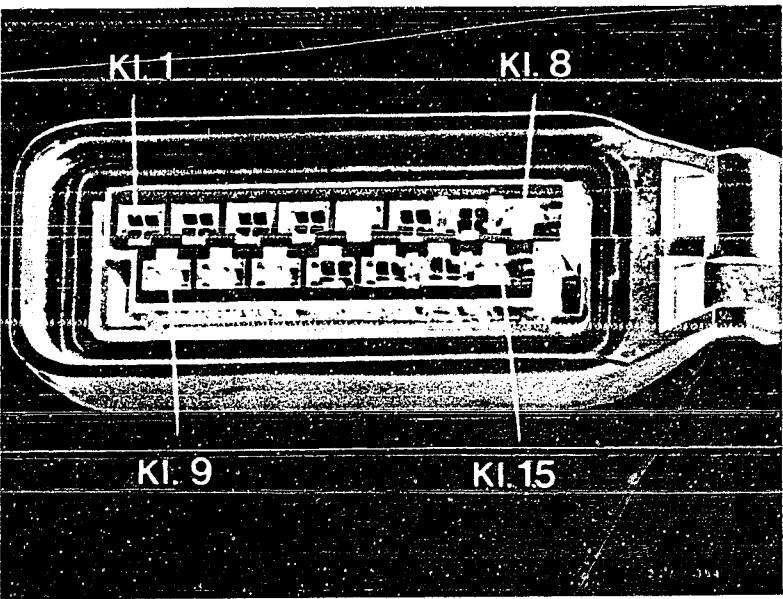
RAPID DIAGNOSIS CHART

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
1	HIGH-VOLTAGE SIDE Check operation (e.g. open circuit, shunt) of, for example, spark plugs, ignition harness, distributor cap etc. Evaluation for example by ignition oscilloscope, resistance measurement, visual examination.	—	—
2	IGNITION COIL Visual examination: plug present, sealing compound escaped? Resistance, primary Resistance, secondary	— 1 15 1 4	— 0,6...1,0 Ω 6,4...11,1 k Ω
3	VOLTAGE, EI CONTROL UNIT Detach EI control-unit plug. Ignition ON. Voltage, EI control-unit plug. See upper illustration.	3 1 (+) (-)	Battery voltage
4	VOLTAGE, TRIGGER BOX Detach trigger-box plug. Ignition ON. Voltage, trigger-box plug. See lower illustration.	3 2 (+) (-)	Battery voltage
5	INSULATION, PULSE GENERATOR EI control-unit plug is detached. Resistance, EI control-unit plug. See upper illustration.	1 12	infinity Ω



RAPID DIAGNOSIS CHART (Continued)

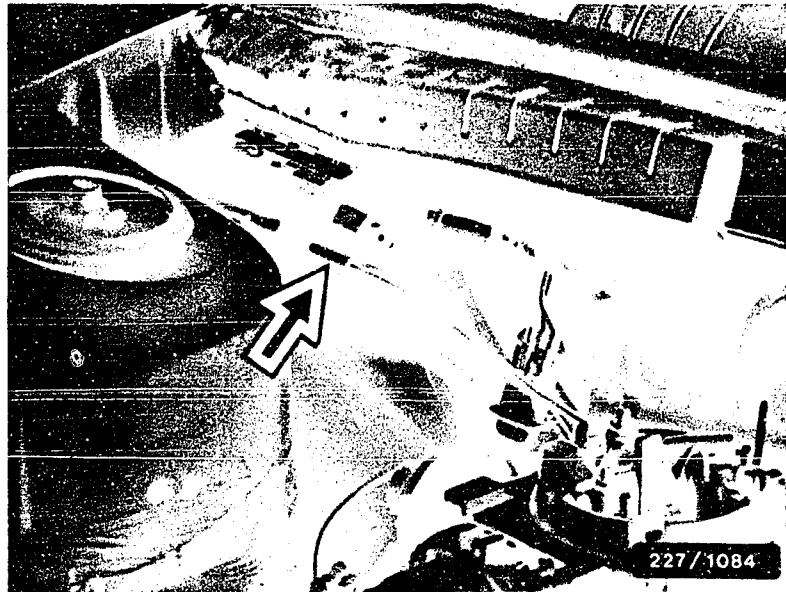
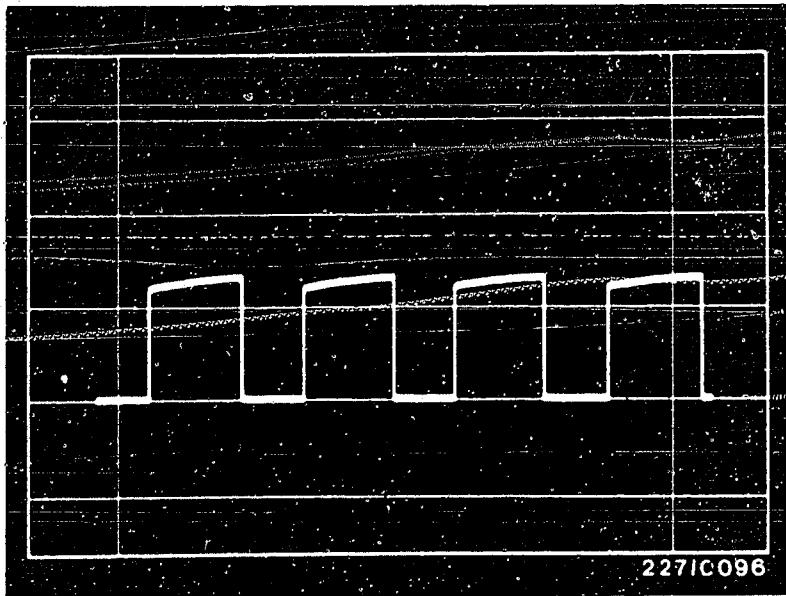
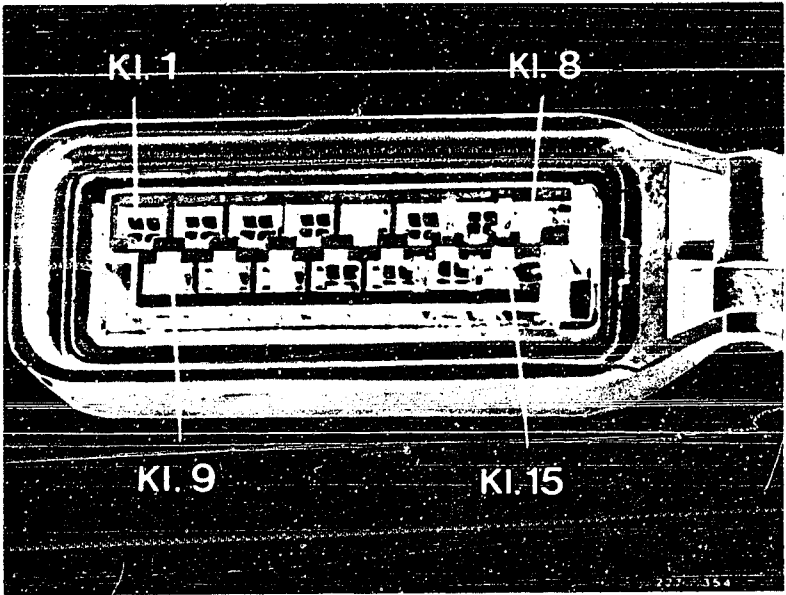
Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
6	INTERNAL RESISTANCE, PULSE GENERATOR EI control-unit plug is detached. Resistance, EI control-unit plug. See upper illustration.	11 12	445...785 Ω
7	VOLTAGE, PULSE GENERATOR EI control-unit plug is detached. "Special" oscilloscope to EI control-unit plug. See upper illustration. Start engine.	12 11 (+) (-)	equal to/greater than 1,0 V (center illus.)
8	EI CONTROL UNIT OPERATION Insert EI control-unit plug. Trigger-box plug is detached. "Special" oscilloscope to trigger-box plug. Start engine.	4 2 (+) (-)	Rectangular pulse (lower illustration)
9	PRIMARY SIGNAL Insert trigger-box plug. Oscilloscope/engine-speed tester to ignition coil. Start engine.	15 1 (+) (-)	Primary voltage/ engine-speed indic. (whatever level)
10	CONTACT RESISTANCES Detach negative and positive lead from battery. Ignition ON. Resistance from battery terminal to trigger-box plug.	B+ 3 B- 2	max.0,5 Ω



RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
11 *	ENGINE-SPEED SIGNAL EI control-unit plug is inserted. Detach LE-Jetronic control-unit plug. "Special" oscilloscope to LE-Jetronic control-unit plug. See upper illustration. Start engine.	1 B- (+) (-)	Rectangular pulse (center illustration)
12 **	OPERATION OF PRESSURE SENSOR Insert LE-Jetronic control-unit plug. Connect motortester to TDC sensor. Detach vacuum hose EI control unit. See lower illustration, arrow. Run engine at approx. 2000 min ⁻¹ and read off spark-advance angle. Connect EI control unit vacuum hose.	—	Noticeable change in spark-advance angle (in direction of advanced)
13**	PRESSURE SENSOR, LEAKAGES Detach vacuum hose from EI control unit. Connect vacuum pump to EI control unit. Establish vacuum of 600 mbar.	—	Vacuum must not noticeably drop

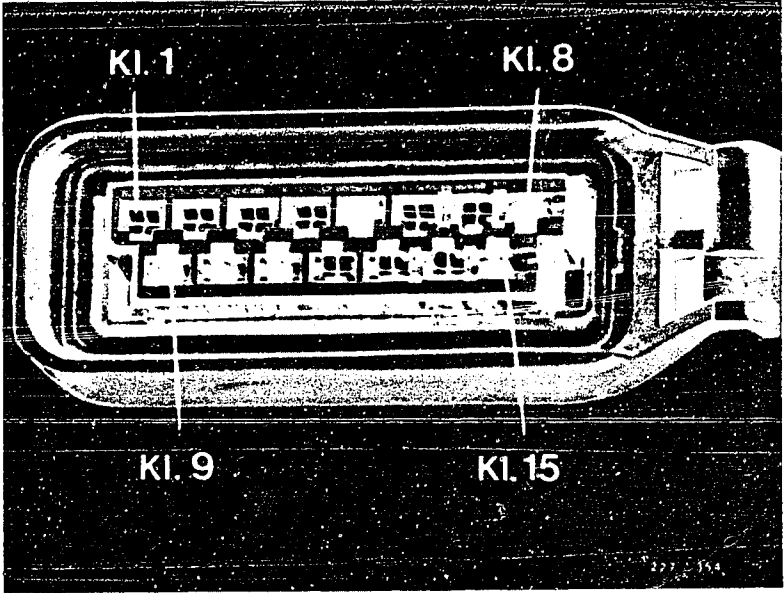
*With fuel-injection engine only. ** With carburetor engine only



RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
14*	THROTTLE-VALVE SWITCH, IDLE Detach LE-Jetronic and EI control-unit plugs. See illustration. Resistance EI control-unit plug. Throttle valve to idle position. Open throttle valve 1...2°.	6 1	Approx. 0 Ω (continuity) Infinity Ω
15*	THROTTLE-VALVE SWITCH, FULL LOAD LE-Jetronic and EI control-unit plugs are detached. Resistance, EI control-unit plug. See illus. Fully depress accelerator pedal. Release accelerator pedal (idle position).	14 1	Approx. 0 Ω (continuity) Infinity Ω
16	TEMPERATURE SENSOR, ENGINE EI control-unit plug is detached. Resistance, EI control-unit plug (see illus.) at temperature: <div>+ 20° C = + 30° C = + 80° C = + 90° C = +100° C =</div>	7 2	2,1...2,9 k Ω 1,4...2,0 k Ω 280...370 Ω 210...280 Ω 160...210 Ω

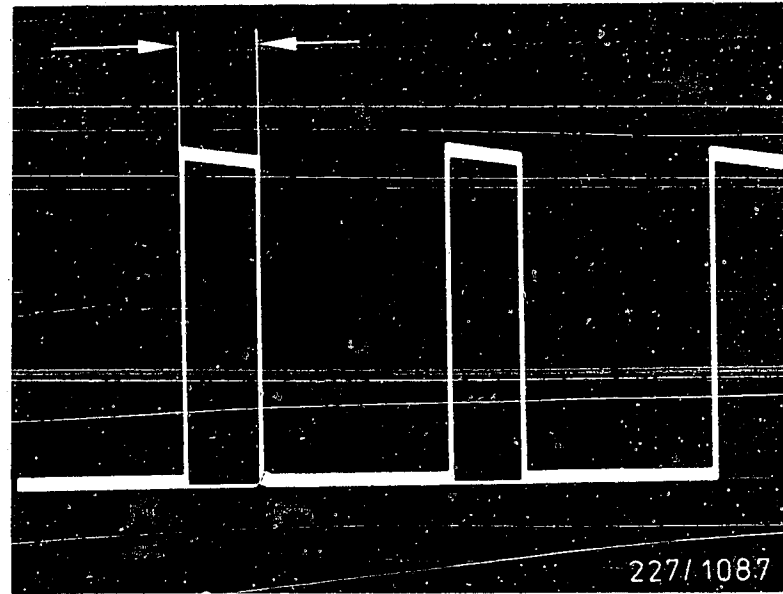
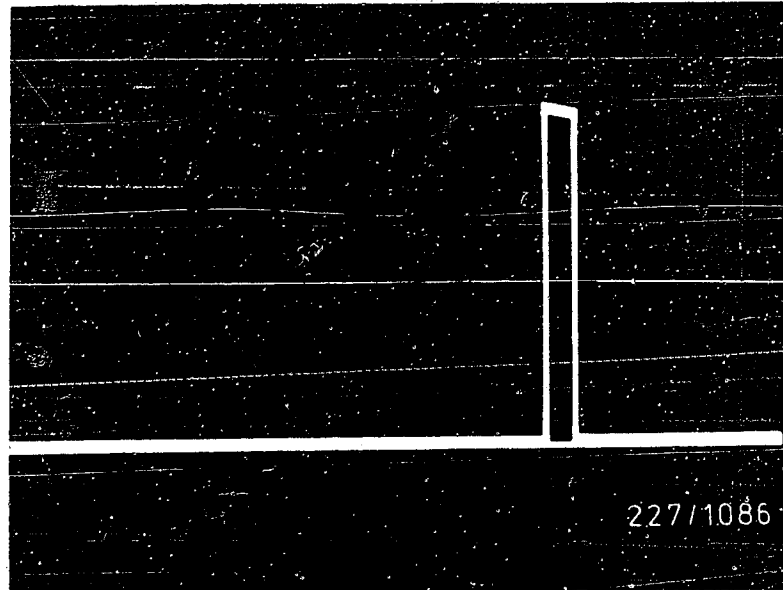
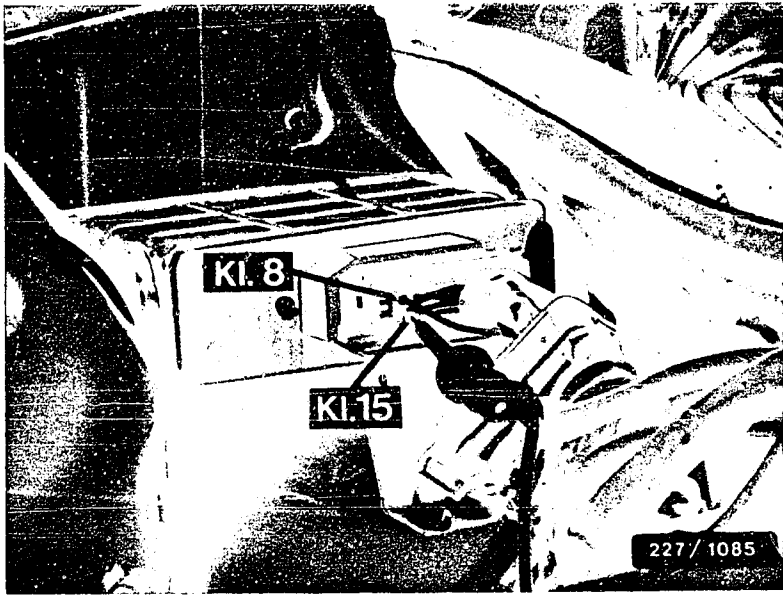
* With fuel-injection engine only



RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
17 *	LOAD SIGNAL Insert LE-Jetronic control-unit plug. Insert EI control-unit plug with handle cover removed. See upper illustration. Engine at idle. Load signal must be present. Briefly open throttle fully (abrupt acceleration) and observe load signal. Pulse duration must noticeably change.	15 B- (+) (-)	Load signal (center illus.) Load signal (lower illus., arrow)
18	VOLTAGE SUPPLY, IGNITION COIL Voltage, ignition coil and battery. Engine at idle.	15 B- (+) (-)	equal to/greater than 10 V
19	OCTANE-NUMBER ADAPTATION Detach EI control-unit plug. Resistance, EI control-unit plug. Encoding-plug color: black (octane 95) black (octane 91) yellow (octane 95) yellow (octane 91) brown (octane 98) brown (octane 95) green (octane 98) green (octane 95) white (octane 98) white (octane 95)	8 10	220 Ω 0 Ω 2200 Ω infinity Ω 470 Ω 220 Ω 4700 Ω infinity Ω 750 Ω 2200 Ω

* With fuel-injection engine only



TEST SPECIFICATIONS

Ignition coil, primary	0,6...1,0 Ω
Ignition coil, secondary	6,4...11,1 k Ω

Voltage, EI control unit with ignition ON	Battery voltage
--	-----------------

Voltage, trigger box with ignition ON	Battery voltage
--	-----------------

Insulation, pulse generator	infinity Ω
-----------------------------	-------------------

Internal resistance, pulse generator	445...785 Ω
---	--------------------

Voltage, pulse generator at starting speed	equal to/greater than 1,0 V
---	--------------------------------

Operation of EI control unit at starting speed	Rectangular pulse
---	-------------------

Primary signal at starting speed	Primary voltage/engine- speed indication (whatever level)
-------------------------------------	---

TEST SPECIFICATIONS (Continued)

Contact resistances	
Supply lines	
Trigger box	max. 0,5 Ω

Engine-speed signal at starting speed	Rectangular pulse
--	-------------------

Operation of pressure sensor	
Run engine at 2000 min ⁻¹	
Detach vacuum hose and reattach.	Noticeable change in spark-advance angle (in direction of advanced)

Pressure sensor, leakages	
Establish vacuum of 600 mbar	Vacuum must not noticeably drop.

Throttle-valve switch, idle	
Throttle valve, idle setting	approx. 0 Ω
Open throttle valve 1...2°	infinity Ω

TEST SPECIFICATIONS (Continued)

Throttle-valve switch,
full load
Fully depress accelerator pedal approx. 0 Ω
Accelerator pedal idle position infinity Ω

Temperature sensor, engine
+ 20° C = 2,1...2,9 k Ω
+ 30° C = 1,4...2,0 k Ω
+ 80° C = 280...370 Ω
+ 90° C = 210...280 Ω
+100° C = 160...210 Ω

Load signal
Briefly open throttle fully Pulse duration
must change

Voltage, ignition coil
with engine at idle equal to/greater
than 10 V

TEST SPECIFICATIONS (Continued)

Encoding plug black (octane 95) 220 Ω
black (octane 91) 0 Ω
yellow (octane 95) 2200 Ω
yellow (octane 91) infinity
brown (octane 98) 470 Ω
brown (octane 95) 220 Ω
green (octane 98) 4700 Ω
green (octane 95) infinity
white (octane 98) 750 Ω
white (octane 95) 2200 Ω

For settings of idle speed, exhaust gas etc.
see SIS Microcard LE-Jetronic or Autodata Test
Specifications.

INSTALLATION POSITION OF COMPONENTS

The EI control unit is located in the engine compartment, at the rear on the right.

The encoding plug is located on the wiring harness of the EI control unit.

The trigger box and ignition coil are located beneath the battery.

The engine-temperature sensor is located close to the oil filter.

The pulse generator is located close to the oil dipstick.

The throttle-valve switch is located on the throttle-valve assembly.

The high-voltage distributor is located behind the cylinder head.

The LE-Jetronic control unit is located on the air-flow sensor.

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions : POR-5002
BOSCH system : EZ-K
Make of vehicle : PORSCHE
Basic microcard : PKW-072

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Porsche model: 928 S 4 with 5.0 l/ 8-cyl. engine 8. 86 -> Engine type M 28/41 (manually shifted transmission) M 28/42 (automatic)

- * EI-K control unit 0 227 400 035,..043
- * Trigger box 0 227 100 124 (with current limitation)
- * Ignition coil 0 221 118 322
- * Transmission overload protection
- * Characteristic-map encoding
- * Self-diagnosis (see note)

Note:
Listed in the following table are the vehicle identification numbers (chassis nos.) of vehicles as of which "diagnosis-capable" EI-K control units have been installed.

Country	Chassis-number range
R. o. W.	WPO ZZZ 92 Z JS 84 0001...5000
Japan	WPO ZZZ 92 Z JS 84 9501...9999
USA	WPO JBO 92 - JS 86 0001...5000

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to various causes/component faults.
For a detailed description of trouble-shooting, see the instructions in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to prevent damage to the engine, trigger boxes, and control units, or to the ignition system, be sure to observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

When testing the compression, disconnect the trigger-box plug or apply ignition coil term. 4
firmly to ground with auxiliary cable.

Note: Auxiliary cable must be interference-suppressed with at least 2 kΩ.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1.	Starting motor operates, but engine fails to start or starts only with difficulty.									
2.	Engine starts but then dies.									
3.	Rough idling (engine speed, exhaust gas).									
4.	Poor throttle response, flat spot during acceleration.									
5.	Engine misfiring (ignition, fuel injection).									
6.	Maximum engine power/top speed not reached.									
7.	Fuel consumption too high.									
8.	Engine running on (dieseling).									
9.	Engine pinging/knocking.									
10.	Engine overheating.									
11.	Fault lamp.									
Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Self diagnosis
*			*							High-voltage side
*										Firing sequence
*			*							Ignition coil
*										Voltage, trigger boxes
*										Voltage, primary circuits
*										Voltage, EI-K control unit
*										Insulation, engine-speed and reference-mark sensors
*										Internal resistance, engine-speed and reference-mark sensors

TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

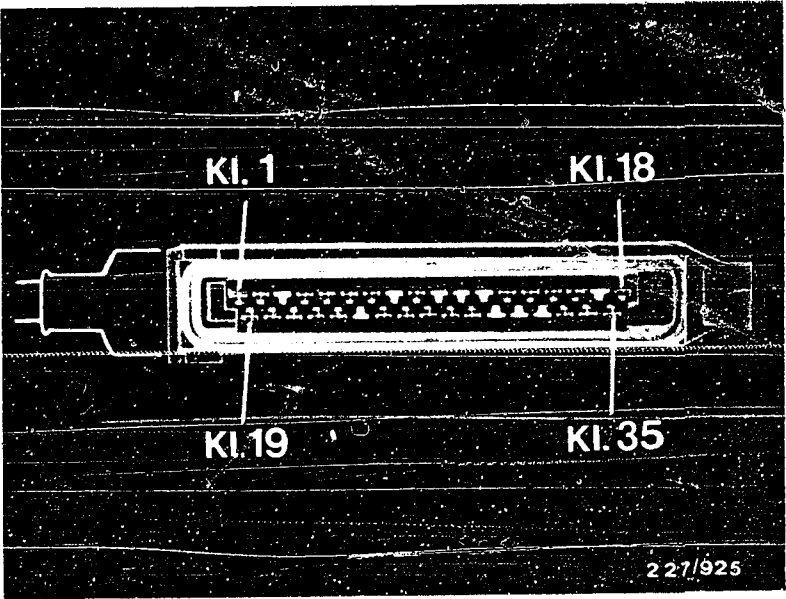
- Starting motor operates, but engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Rough idling (engine speed, exhaust gas).
- Poor throttle response, flat spot during acceleration.
- Engine misfiring (ignition, fuel injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on (dieseling).
- Engine pinging/knocking.
- Engine overheating.
- Fault lamp.

Cause (component fault)									
*									Voltage, engine-speed and reference-mark sensors
*									Trigger boxes - activation
*									Contact resistances (primary side)
			*						Voltage, trigger box (engine idle)
			*						Voltage, ignition coil (engine idle)
			*						Primary voltage

For production reasons:
continued on the following
coordinate.

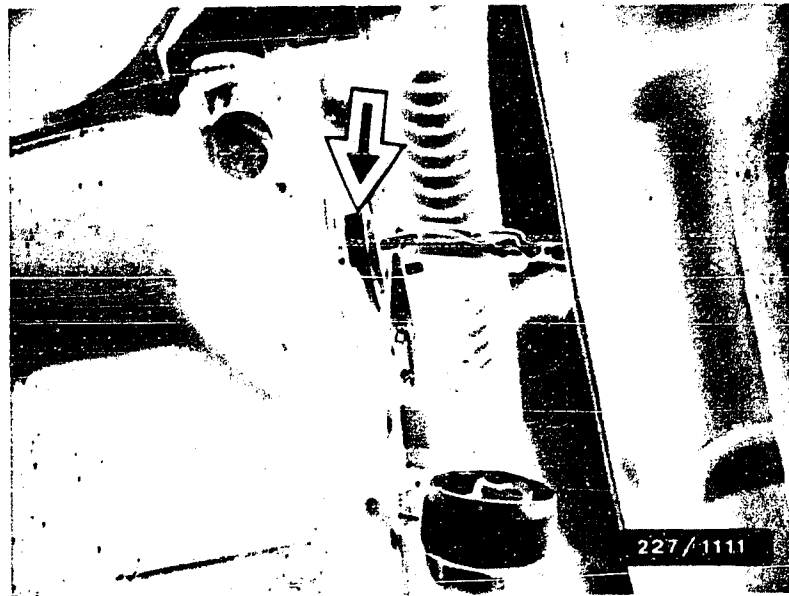
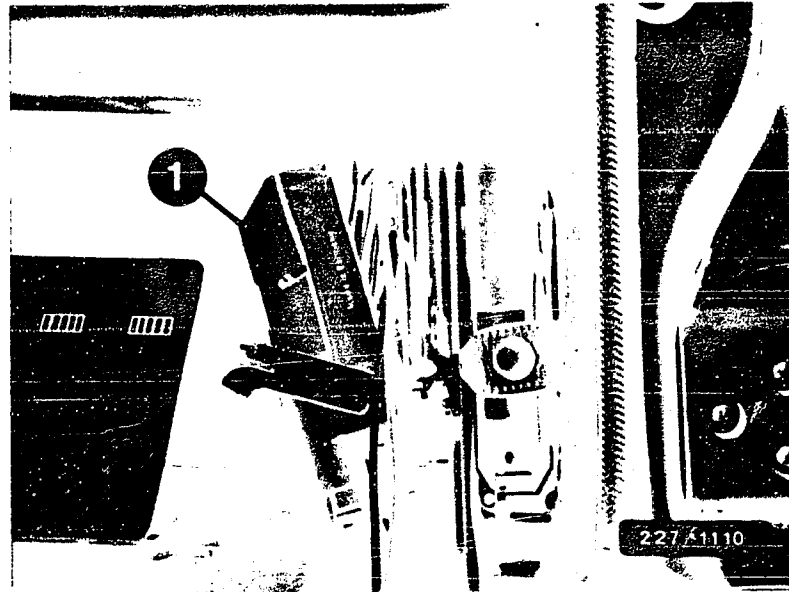
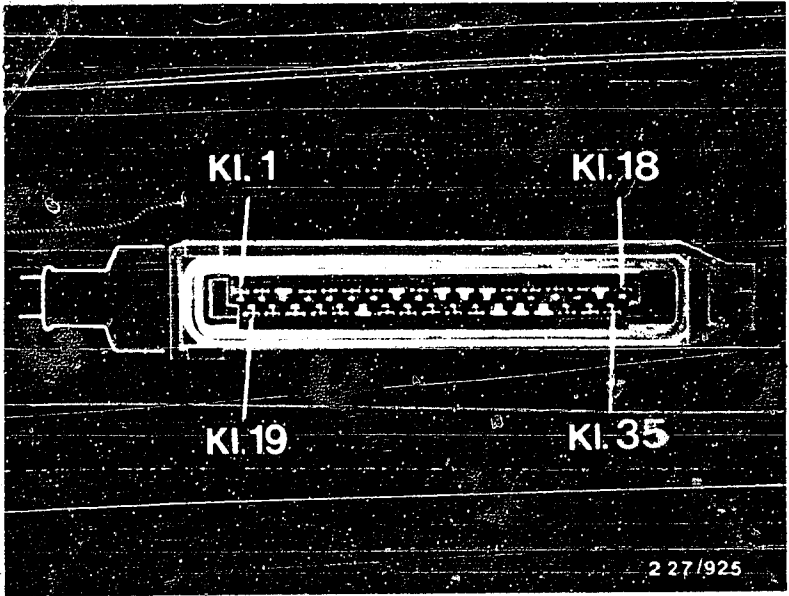
SELF-DIAGNOSIS TEST TABLE

Fault indication Fault code	Testing of component/function Test instructions/conditions	Termi- nals	Set values
2	END OF FAULT OUTPUT	—	—
25	NO FAULT STORED	—	—
2112 / 2212 2115 / 2215	IDLE THROTTLE-VALVE SWITCH Disconnect LH-Jetronic control-unit plug. See illustration. Resistance, EI-K control-unit plug. See illustration. Throttle valve in idle position. Open throttle valve approx. 1°.	8 18	Approx. 0 Ω (continuity) infinity Ω
2113 / 2213 2115 / 2215	FULL-LOAD THROTTLE-VALVE SWITCH Disconnect LH-Jetronic control-unit plug. See illustration. Resistance, EI-K control-unit plug. See illustration. Fully depress accelerator pedal to floor. Release accelerator pedal (idle position)	18 26	Approx. 0 Ω (continuity) infinity Ω
2114 / 2214	COOLANT-TEMPERATURE SENSOR Resistance, EI-K control-unit plug. See illustration.	18 19	+ 20°C= 2.1–2.9 k Ω + 30°C= 1.4–2.0 k Ω + 80°C= 280–370 Ω + 90°C= 210–280 Ω +100°C= 160–210 Ω



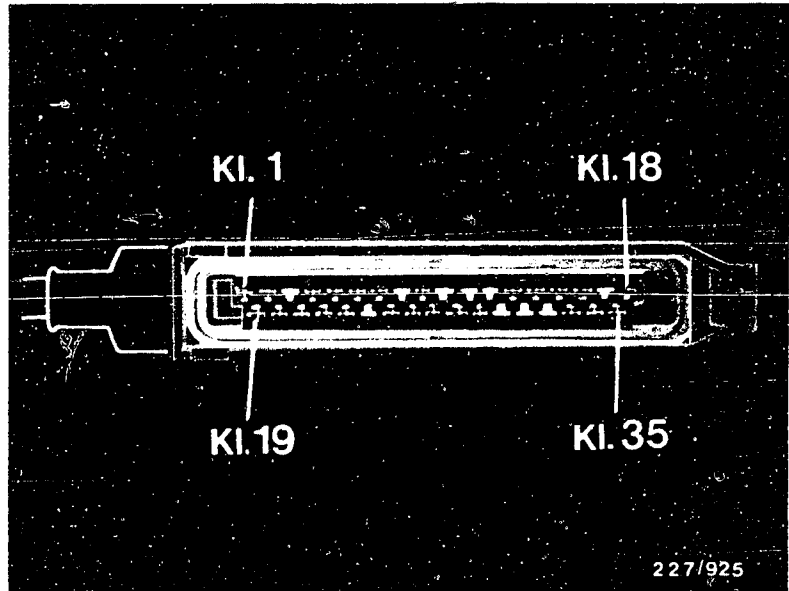
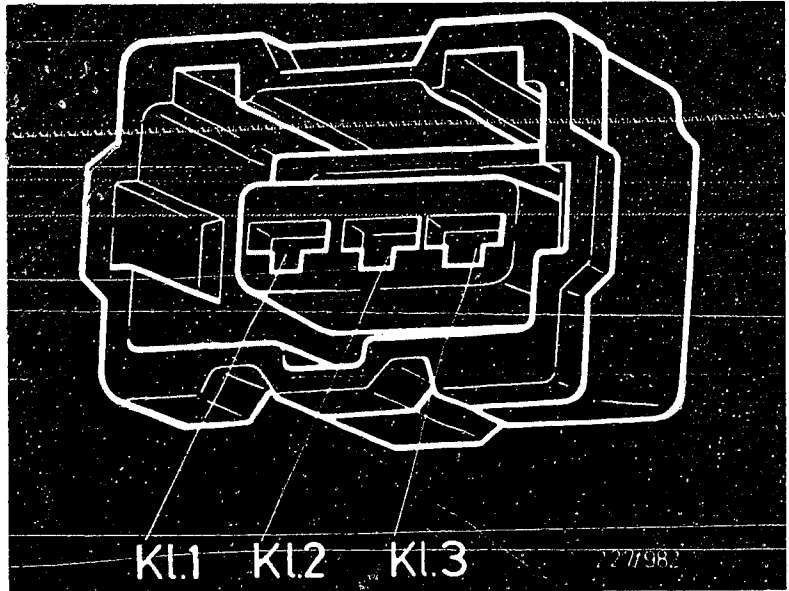
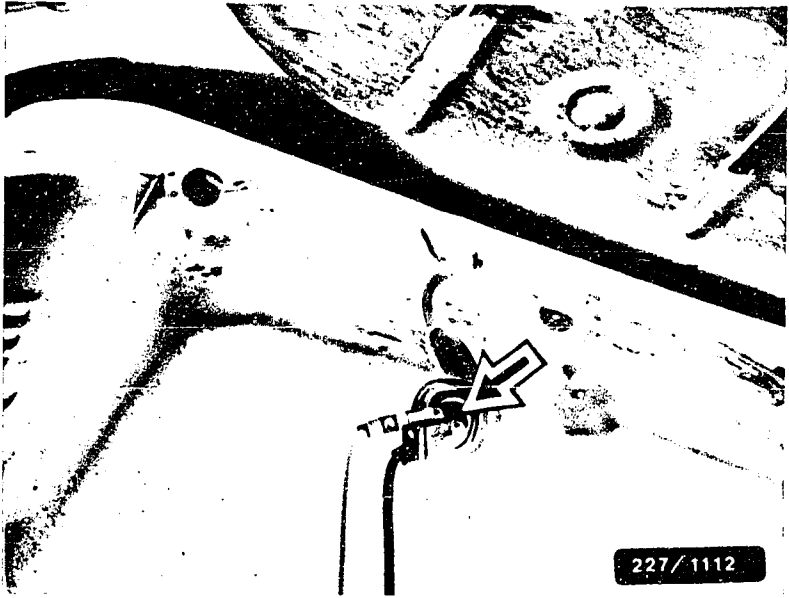
SELF-DIAGNOSIS TEST TABLE (Continued)

Fault indication Fault code	Testing of component/function Test instructions/conditions	Termi- nals	Set values
2121 / 2221	<p>LOAD SIGNAL</p> <p>Resistance, EI-K and LH-Jetronic control-unit plugs. See upper illustration. Connect LH-Jetronic control-unit plug.</p> <p>Voltage, EI-K control-unit plug with handle cover removed. See center illustration, Item 1. Engine at idle. Note: ANALOG VOLTMETER (small measuring range).</p> <p>Briefly depress accelerator pedal fully to floor (snap acceleration). Watch voltmeter.</p>	<p>9 25</p> <p>9 18 (+) (-)</p>	<p>approx. 0 Ω (continuity)</p> <p>0.1...1 V</p> <p>Voltage increases slightly</p>
2126 / 2226	<p>TRANSMISSION OVERLOAD PROTECTION</p> <p>Resistance, overload-protection switch. See lower illustration, arrow. Engine at idle. Apply handbrake. Observe safety regulations (e.g. chocks at rear wheels). Transmission selection-lever position selected: Driving position "N" or "P" Driving position "D" Ignition OFF. Continued on next coordinate.</p>	<p>—</p> <p>—</p>	<p>greater than 20 k Ω (open circuit) less than 1 Ω (continuity)</p>



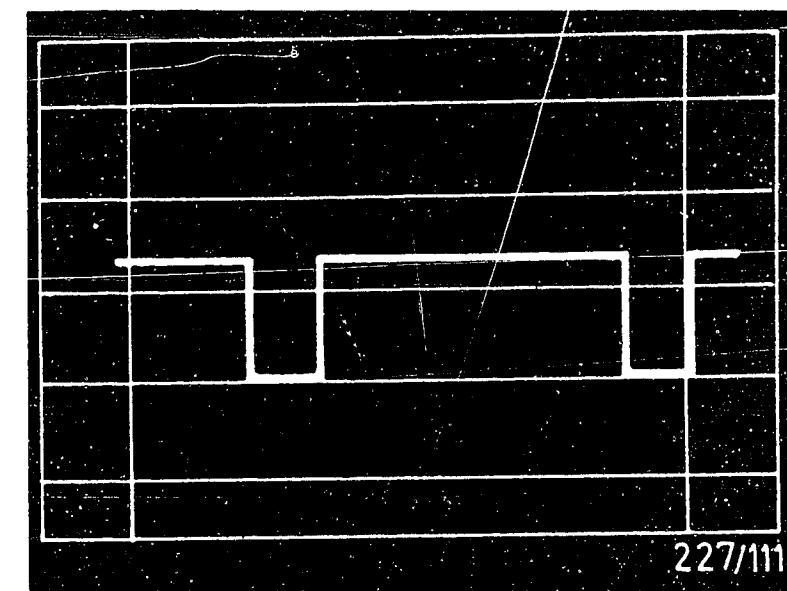
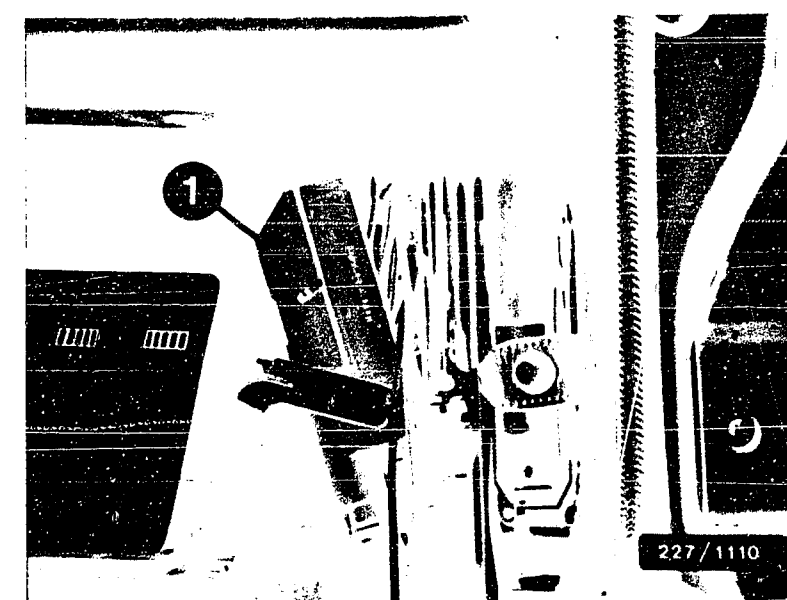
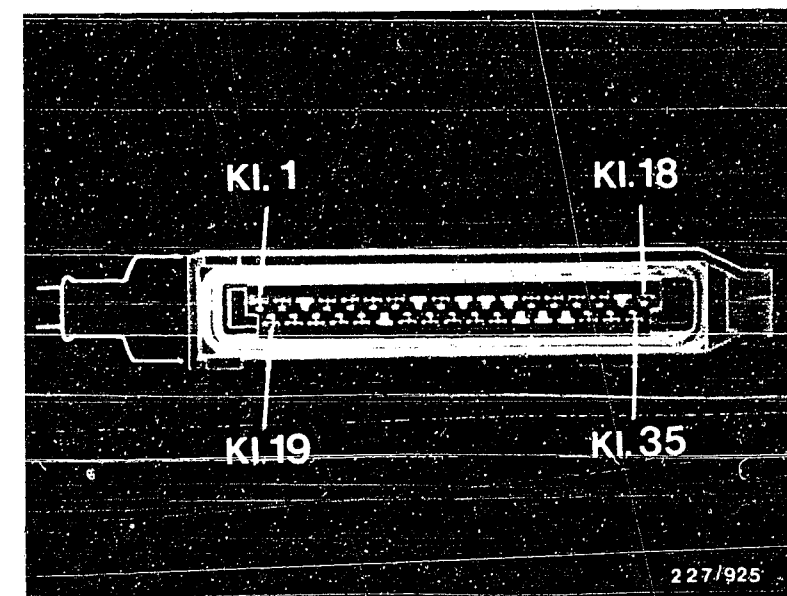
SELF-DIAGNOSIS TEST TABLE (Continued)

Fault indication Fault code	Testing of component/function Test instructions/conditions	Termi- nals	Set values
2126 / 2226	TRANSMISSION OVERLOAD PROTECTION (Cont.) Voltage, coupling of transmission over- load-protection switch. See upper illustration, arrow. Ignition ON.	—	approx. 10 V
2131 / 2231	KNOCK SENSOR CYL. 1 - 2 - 5 - 6 Visual examination, knock-sensor plug-in connection (oxidation). See center illustration. Resistance, knock-sensor plug-in connec- tion and EI-K control-unit plug. See center and lower illustrations. Resistance, EI-K control-unit plug. See lower illustration. Tightening torque (time required approx. 6 hours).	1 20 2 2 3 2 18 20	Approx. 0 Ω Approx. 0 Ω Approx. 0 Ω Infinity Ω 15-25 Nm
2132 / 2232	KNOCK SENSOR CYL. 3 - 4 - 7 - 8 Visual examination, knock-sensor plug-in connection (oxidation). See center illustration. Resistance, knock-sensor plug-in connec- tion and EI-K control-unit plug. See center and lower illustrations. Continued on next coordinate.	1 21 2 3 3 3	Approx. 0 Ω Approx. 0 Ω Approx. 0 Ω



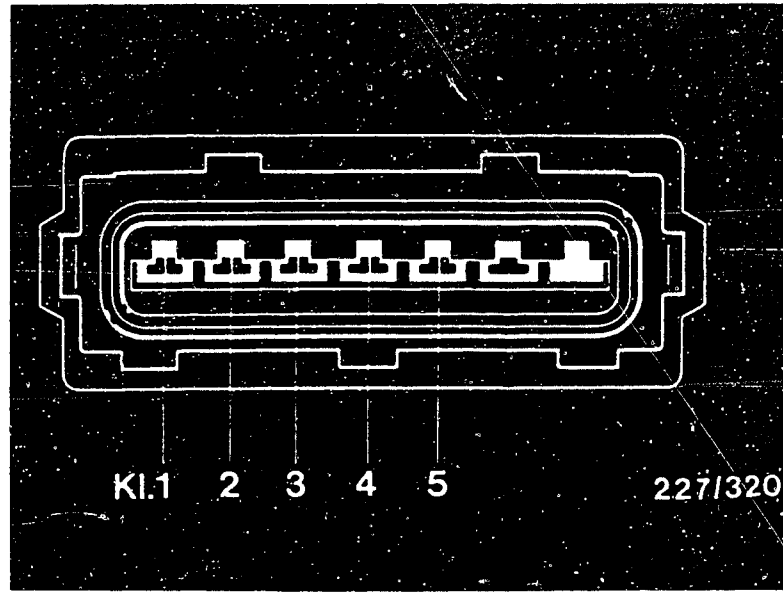
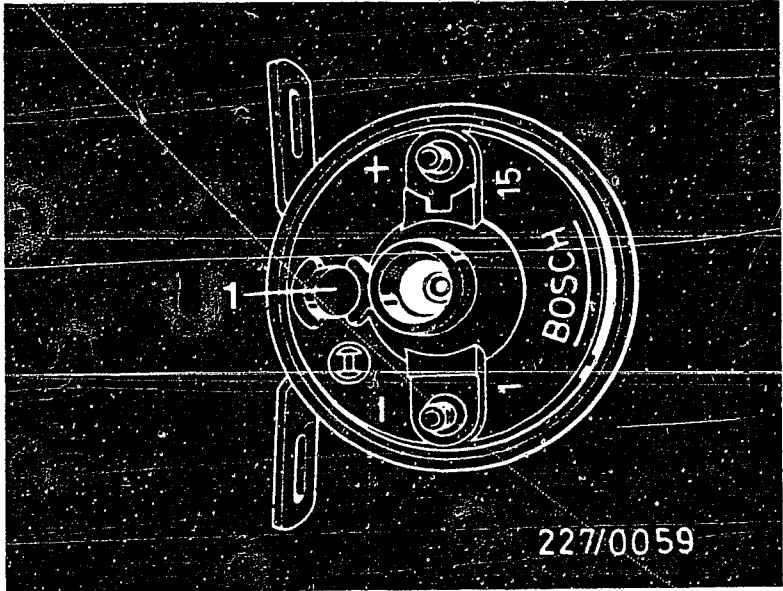
SELF-DIAGNOSIS TEST TABLE (Continued)

Fault indication Fault code	Testing of component/function Test instructions/conditions	Terminals	Set values
2132 / 2232	<p>KNOCK SENSOR CYL. 3 - 4 - 7 - 8 (Continued)</p> <p>Resistance, EI-K control-unit plug. See upper illustration.</p> <p>Tightening torque (time required approx. 6 hours).</p>	18 21	<p>infinity Ω</p> <p>15-25 Nm</p>
2133 / 2233	<p>EI-K CONTROL UNIT (evaluation circuit)</p> <p>EI-K control unit defective.</p>	—	—
2134 / 2234	<p>HALL-GENERATOR CYLINDER RECOGNITION</p> <p>Rectangular pulse, EI-K control-unit plug with handle cover removed. See center illustration, Item 1.</p> <p>Start engine.</p>	22 B- (+) (-)	Rectangular pulse (see lower illustration)
2141 / 2241	<p>EI-K CONTROL UNIT</p> <p>EI-K control unit defective.</p>	—	—



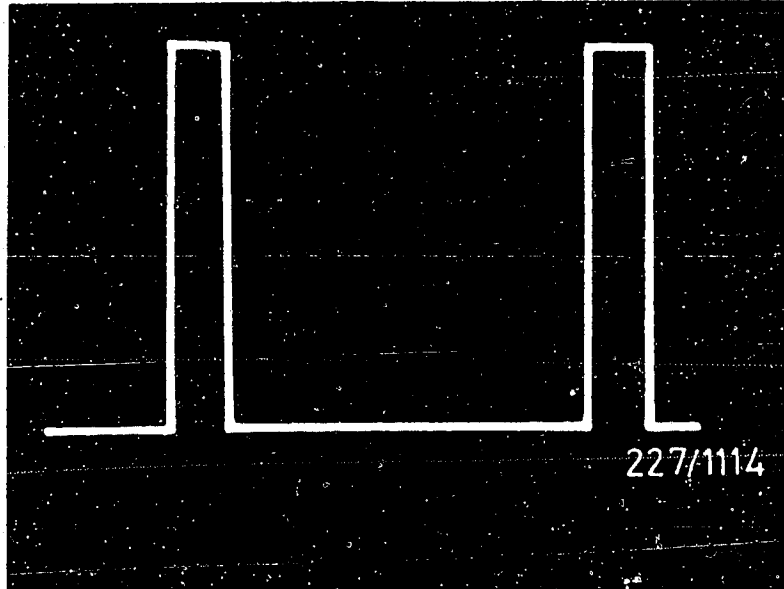
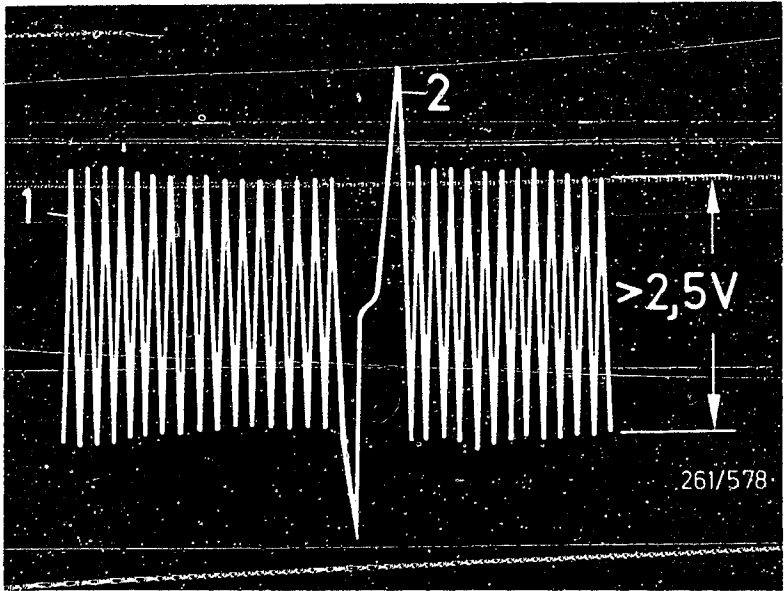
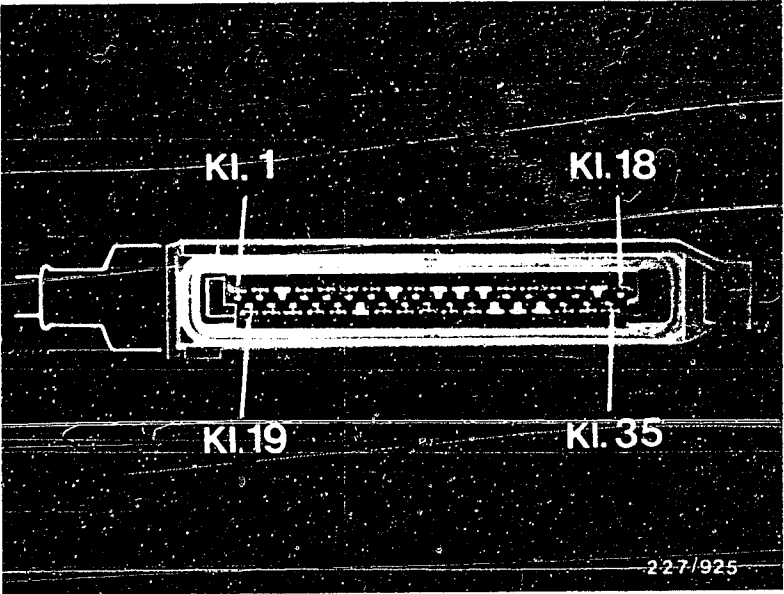
RAPID DIAGNOSIS CHART

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
1	HIGH-VOLTAGE SIDE Test for proper functioning of, for example, spark plugs, ignition harness, distributor cap etc. (e.g. open circuit, shunt). Assessment, for example, by means of ignition oscillogram, resistance measurement, visual examination.	—	—
2	IGNITION COIL Following test must be conducted on both ignition coils. Visual examination: plug present, sealing compound escaped? See upper illustration. Resistance, primary Resistance, secondary	 1 15 1 4	 0.4–0.7 Ω 4.9–8.7 k Ω
3	VOLTAGE, TRIGGER BOXES Following test must be conducted on both trigger-box plugs. Disconnect trigger-box plug. Ignition ON. Voltage, trigger-box plug. See lower illustration.	 4 2 (+) (–)	 Battery voltage
4	VOLTAGE, PRIMARY CIRCUITS Following test must be conducted on both trigger-box plugs. Disconnect trigger-box plug. Ignition ON. Voltage, trigger-box plug. See lower illustration.	 1 2 (+) (–)	 Battery voltage



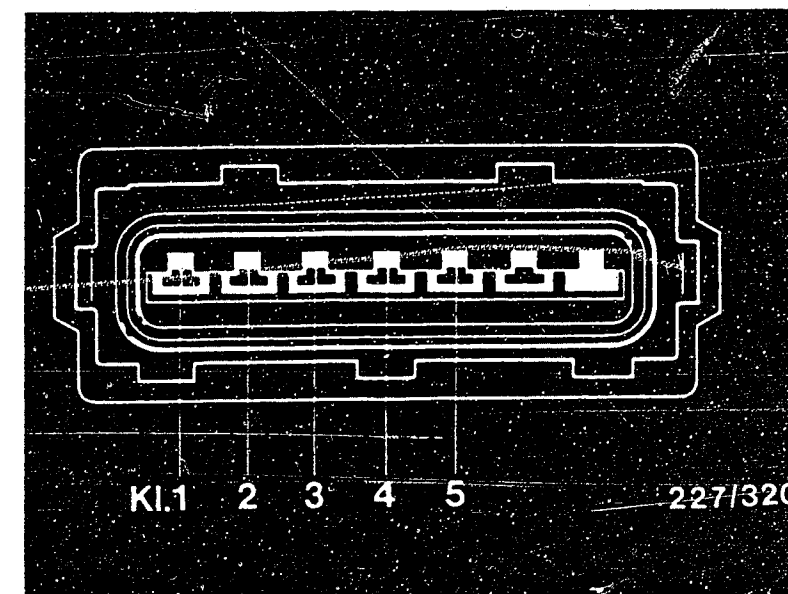
RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
5	VOLTAGE, EI-K CONTROL UNIT Disconnect EI-K control-unit plug. Ignition ON. Voltage, EI-K control-unit plug. See upper illustration.	29 18 (+) (-)	Battery voltage
6	INSULATION, ENGINE-SPEED AND REFERENCE-MARK SENSORS Disconnect EI-K control-unit plug. Resistance, EI-K control-unit plug. See upper illustration.	23 24	infinity Ω
7	INTERNAL RESISTANCE, ENGINE-SPEED AND REFERENCE-MARK SENSORS Disconnect EI-K control-unit plug. Resistance, EI-K control-unit plug. See upper illustration.	6 23	0.6–1.6 k Ω
8	VOLTAGE, ENGINE-SPEED AND REFERENCE-MARK SENSORS Disconnect EI-K control-unit plug. Oscilloscope "Special" to EI-K control-unit plug. See upper illustration. Start engine.	23 6 (+) (-)	Engine-speed signal equal to / greater than 2.5 V (center illus.)
9	TRIGGER-BOX ACTIVATION Following test must be conducted on both trigger-box plugs. Disconnect trigger-box plug. Oscilloscope "Special" to trigger-box plug. Start engine.	5 2 (+) (-)	Rectangular pulse (lower illustration)



RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
10	<p>CONTACT RESISTANCES (Primary side)</p> <p>Following test must be conducted on both trigger-box plugs. See illustration.</p> <p>Disconnect neg. and pos. cables from battery. Ignition ON.</p> <p>Resistance of battery terminal to trigger-box plug.</p> <p>Resistance of battery terminal to ign. coil.</p> <p>Resistance of trigger-box plug to ign. coil.</p>	<p>B+ 4 B- 2</p> <p>B+ 15 1 1</p>	<p>Max. 0.3 Ω</p> <p>Max. 0.3 Ω</p>
11	<p>VOLTAGE, TRIGGER BOX</p> <p>Following test must be conducted on both trigger-box plugs.</p> <p>Push back rubber sleeve of trigger-box plug.</p> <p>Voltage, trigger-box plug.</p> <p>Engine at idle.</p>	<p>4 2 (+) (-)</p>	<p>12-14 V Max. 2 V below U_B</p>
12	<p>VOLTAGE, IGNITION COIL</p> <p>Voltage, ignition coil and battery.</p> <p>Engine at idle.</p>	<p>15 B- (+) (-)</p>	<p>Equal to/greater than 10 V</p>
13	<p>PRIMARY VOLTAGE</p> <p>Oscilloscope with pulse shaper at ign. coil.</p> <p>Engine at idle.</p>	<p>15 1 (+) (-)</p>	<p>295-365 V</p>



TEST SPECIFICATIONS

Idle throttle-valve switch	
Throttle-valve idle position	Approx. 0 Ω
Open throttle valve 1°	Infinity Ω
Full-load throttle-valve switch	
Depress accelerator pedal fully to floor	Approx. 0 Ω
Accelerator-pedal idle position	Infinity Ω
Coolant-temperature sensor	
	+20°C=2.1-2.9 k Ω
	+30°C=1.4-2.0 k Ω
	+80°C=280-370 Ω
	+90°C=210-280 Ω
	+100°C=160-210 Ω
Load signal	
Engine at idle	0.1-1 V
Apply full throttle briefly	Voltage increases slightly

TEST SPECIFICATIONS (Continued)

Transmission overload protection	
Driving position " N " / " P " " D "	greater than 20 k Ω less than 1 Ω
with engine at idle	
Knock sensor, tightening torque	15-25 Nm
Hall-generator cylinder detection at cranking speed	Rectangular pulse
Ignition coil, primary	0.4-0.7 Ω
Ignition coil, secondary	4.9-8.7 k Ω
Voltage, trigger box with ignition ON	
	Battery voltage
Voltage, primary circuits with ignition ON	
	Battery voltage
Voltage, EI-K control-unit plug with ignition ON	
	Battery voltage

TEST SPECIFICATIONS (Continued)

Engine-speed and reference-mark sensors

Insulation	Infinity Ω
Internal resistance	0.6...1.6 k Ω
Voltage at cranking speed	At least 2.5 V

Trigger-box activation	Rectangular pulse
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Contact resistances

Supply leads, trigger box	Max. 0.3 Ω
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Supply leads, ignition coil	Max. 0.3 Ω
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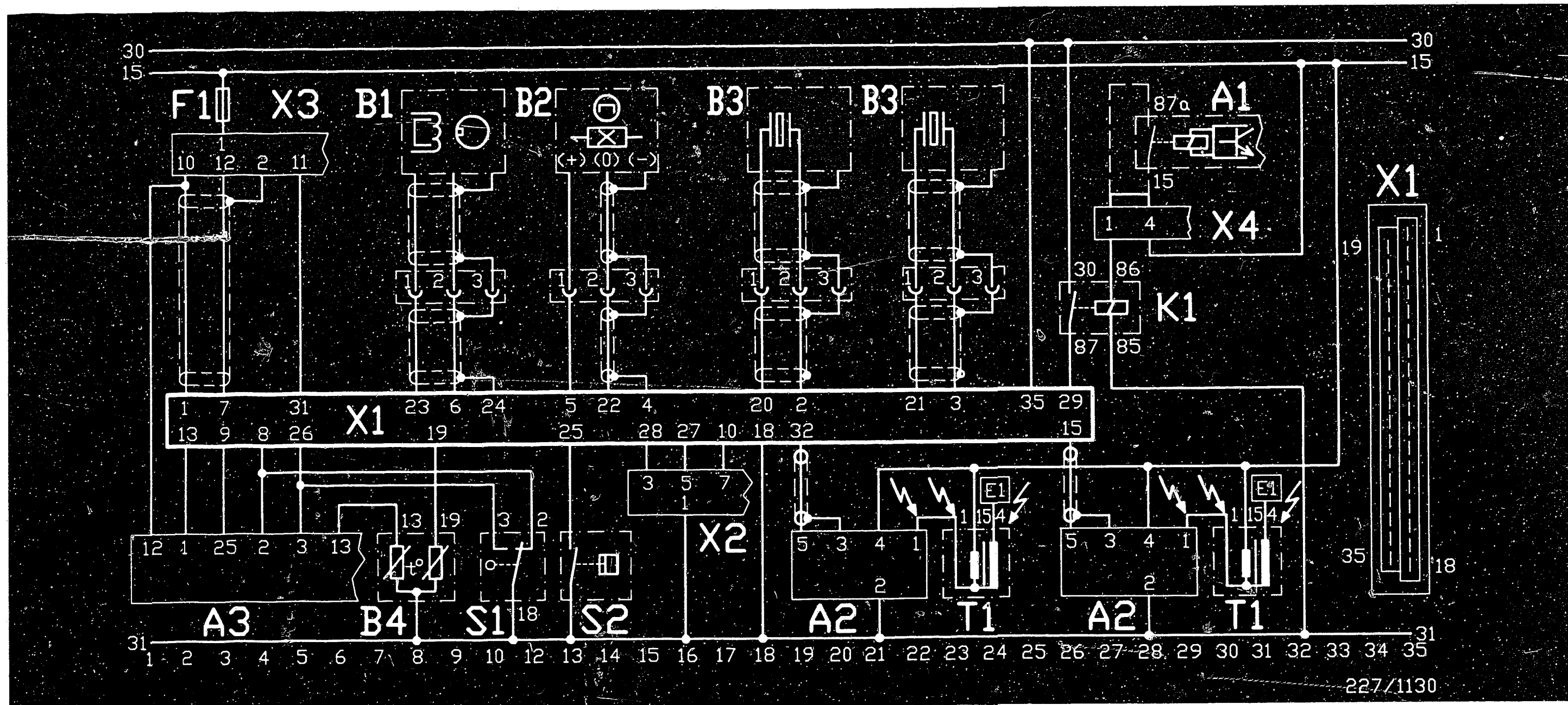
Voltage, trigger box Engine at idle	12...14 V Max. 2 V below U_B
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Voltage, ignition coil Engine at idle	Equal to/greater than 10 V
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Primary voltage Engine at idle	295...365 V
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See SIS microcard LH-Jetronic and test specifications given in Autodata for settings for idle speed, exhaust gas etc.

For production reasons:
continued on the following
coordinate.



High-voltage symbols: Danger 400 V...25 kV

A1 = Alarm control unit
 A2 = Trigger box
 A3 = LH-Jetronic control unit
 B1 = Pulse generator
 B2 = Hall-generator cylinder detection
 B3 = Knock sensor
 B4 = Coolant-temperature sensor
 E1 = To high-voltage distributor
 F1 = Fuse

K1 = EI-K supply relay
 S1 = Throttle-valve switch,
 idle / full load
 S2 = Transmission overload-
 protection switch
 T1 = Ignition coil
 X1 = EI-K control-unit plug
 X2 = Encoding plug
 X3 = Diagnostic plug

ELECTRICAL TERMINAL DIAGRAM

INSTALLATION POSITION OF COMPONENTS

EI-K control unit and LH-Jetronic control unit are located in the footwell on the passenger's side on the right.

Diagnosis connection is located on the control-unit mounting plate.

Trigger boxes are located on the cover-lock transverse wall on the left-hand side.

Coolant-temperature sensor is located behind the oil filler cap.

Knock sensors are located on the upper part of the crankcase.

Hall-generator cylinder detection is located behind the camshaft gear of the row of cylinders 1 - 4 (on the right as seen in the forward direction of travel).

Engine-speed and reference-mark sensor is located at the rear of the engine block beneath the air filter.

Throttle-valve switch is located on the throttle-valve assembly beneath the intake distributor and intake manifold.

Ignition supply relay is located in the central electrics (on passenger's side in the footwell beneath the floor board).

Transmission overload-protection switch is located on the left-hand side of the transmission.

Test connection for adapter lead (TDC sensor) is located on the left-hand side of the engine (in front of the air filter).

Trigger-box ground is located above the right-hand ignition coil.

Engine ground is located between the engine and bodywork.

Electronics ground is located beneath the fuel-pressure regulator and fuel-pressure damper.

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions : BMW-5011
BOSCH system : ABS
Make of vehicle : BMW
Basic microcard : PKW-066

TABLE OF CONTENTS

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Special features.....	02
Structure, usage.....	02
Safety and precautionary measures.....	02
Test requirements.....	03
Rapid diagnosis chart.....	05
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SPECIAL FEATURES

This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following models:

BMW 325 iX, (all-wheel drive)
01.1987 ->

- * ABS with 4 wheel-speed sensors and 3 hydraulic channels.
- * Acceleration sensor (a_L)
- * Signal from clutch switch
- * Engine-drag-torque control

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- * For reasons of safety, the hydraulic modulator must not be repaired, but be exchanged only as a complete unit.
Exception: relays.
- * Do not loosen any screws on the hydraulic modulator!
There would then be danger of fatal accident caused by failure of the brakes.
- * Caution when handling brake fluid.
Poisonous!
- * Only a limited brake test is permitted; no power-output test is permitted.

For further information, see brief instructions.

TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- * Regulatory tire size fitted?
- * Check for firm seating of ground of return-supply pump.
- * Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- * Check for firm seating of ground strap between engine block and vehicle frame.
- * Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- * If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- * If the ABS warning lamp lights up constantly and does not go out, check the following points:
 - Controller plug sitting correctly on controller and latched?
 - All plug contacts O.K.?
 - Spring contacts latched?
 - Check installation position for correct seating of seal ring in controller plug. rounded side downward.

- Check wheel-speed sensor leads at controller plug for correct assignment:

Wheel-speed sensors:

Front left - term. 22 and term. 4.
Front right - term. 11 and term. 21.
Rear left - term. 8 and term. 9.
Rear right - term. 24 and term. 26.

- V-belt torn?
(Alternator does not supply voltage, charging and ABS warning lamp light up).
- * Connect ABS—LED tester to ABS wiring harness.
- Only detach and connect controller with ignition off.
- For test purposes, switch on ignition in all program switch settings (tester runs on power supplied by vehicle battery).
- Observe LED (green) for power supply in all program switch settings.

I M P O R T A N T !

Do not drive with the tester connected!
The entire test program is to be repeated whenever repairs have been carried out.
The ABS system is a vehicle safety system.
Work on this system require detailed knowledge of the system.
The conventional brake system must be working properly.

General trouble-shooting information:

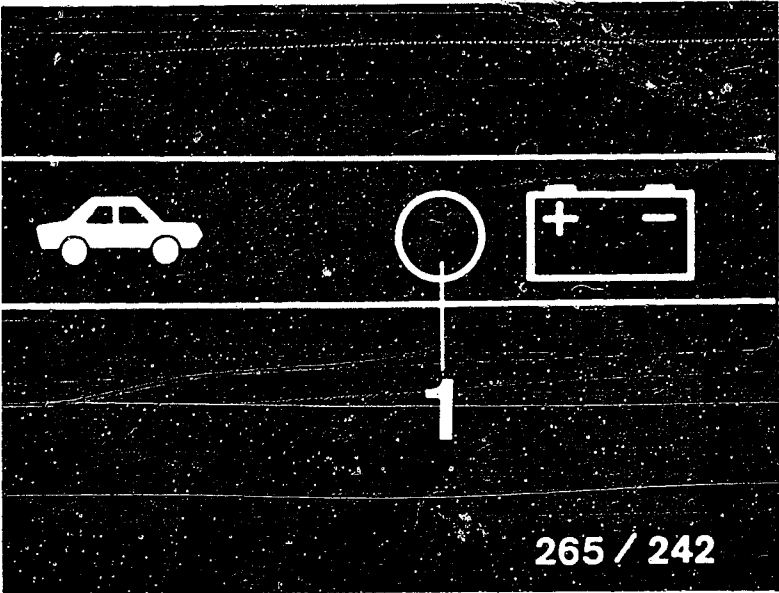
Check all leads for short-circuit to ground and contact with positive leads, as well as for rubbing and pinching.

RAPID DIAGNOSIS CHART

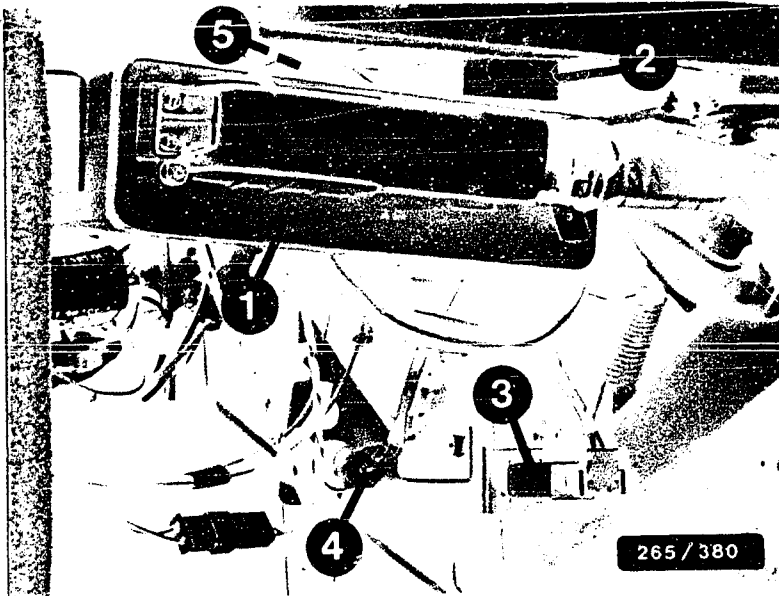
Do not drive with tester connected. Are all test conditions met?

Program-switch positions 1 to 6

Testing of (measurement at terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of faults
Power supply (term.1 und term.20)	Ignition on	LED 1 (top picture) continuously lit	<ul style="list-style-type: none">*Battery insufficiently charged*High voltage drops*Overvoltage-protection relay defective*Check lead to driving switch term.15



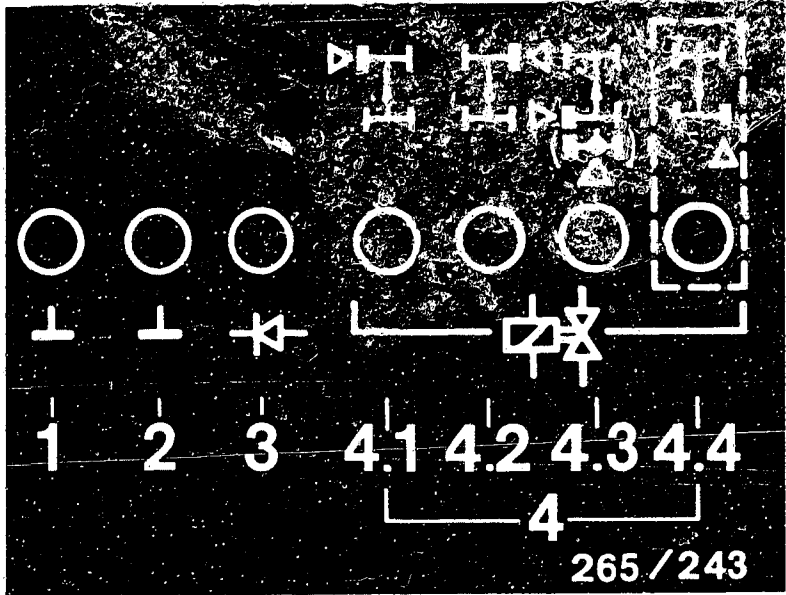
- 1 = Controller
- 2 = Overvoltage-protection relay
- 3 = Stop-lamp switch
- 4 = Clutch switch
- 5 = Ground terminal



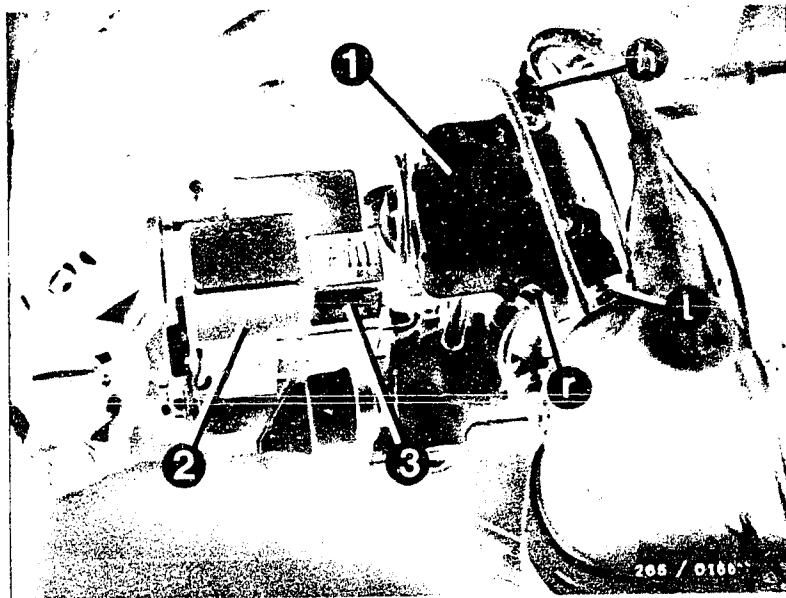
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.—, term.35) Off-position and ground connection of relay ABS warning lamp	Ignition on	6 LED (1 to 4.3) simultaneously brightly lit (top picture) ABS warning lamp in vehicle must light up	<ul style="list-style-type: none">* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit.* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.Solenoid-operated valve internal resistance 6,7...1,7 Ω* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.



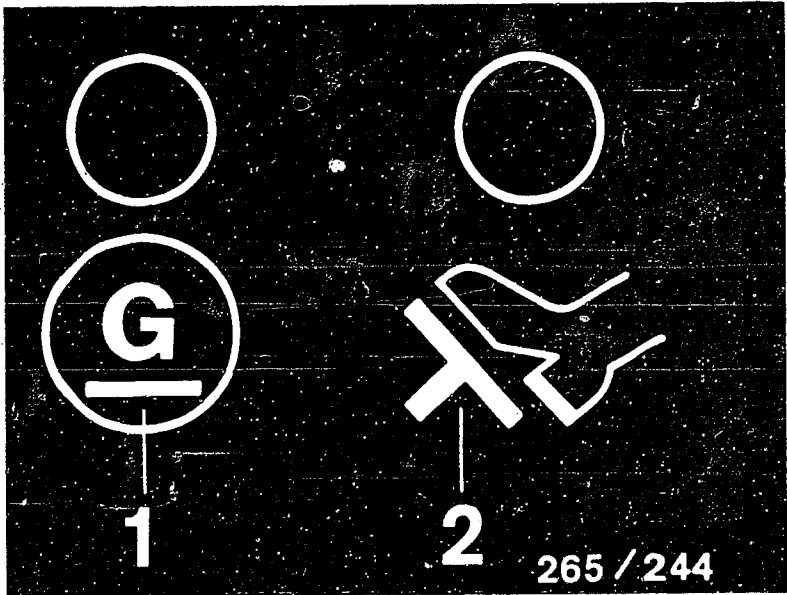
1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 2

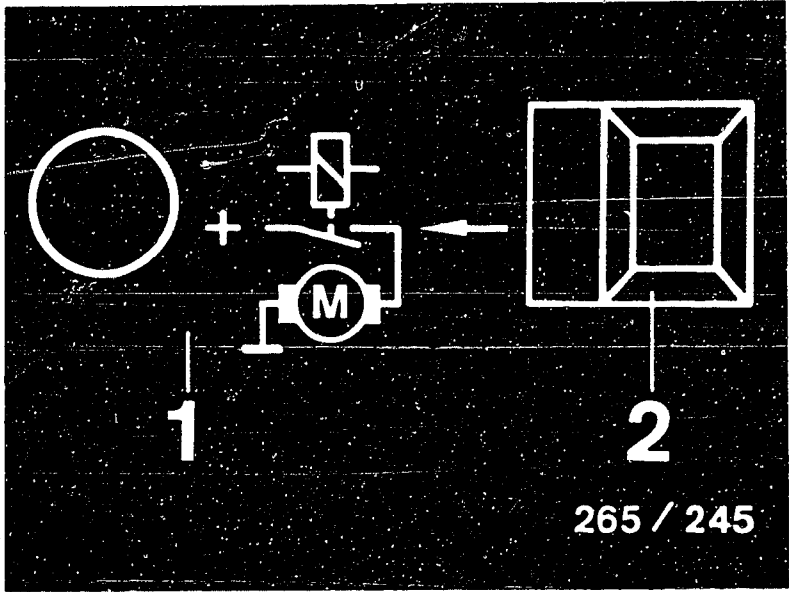
Testing of (Measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Alternator voltage from term.61 (term.15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Check lead to alternator term.61 * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective. * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.



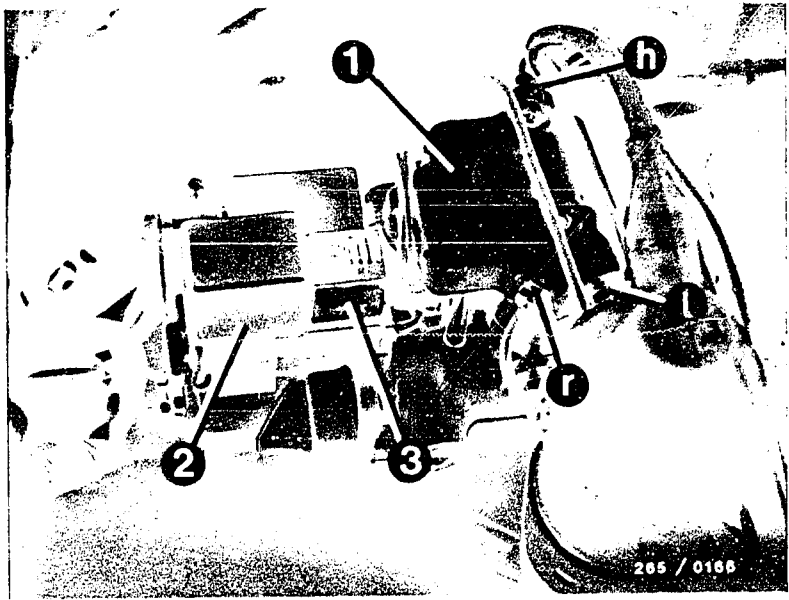
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 3

Testing of (measurement at terminals)	Additional operation	Test specifi- cations (reading)	Possible causes of faults
Motor relay, Pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, Press button 2 continuously (top picture)	LED 1 lit, pump motor running. After button is released, LED continues to light due to running-on of motor (top picture).	<ul style="list-style-type: none">* Motor relay defective* Check ground connection and positive terminal of hydraulic modulator* Check leads from controller term.14 and term.28 to hydraulic modulator term.9 and term. 11.* Pump motor defective



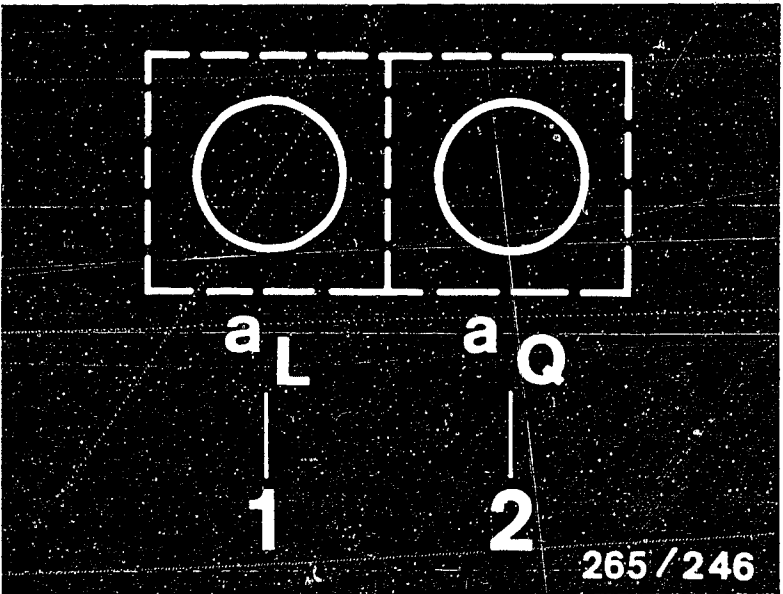
1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay



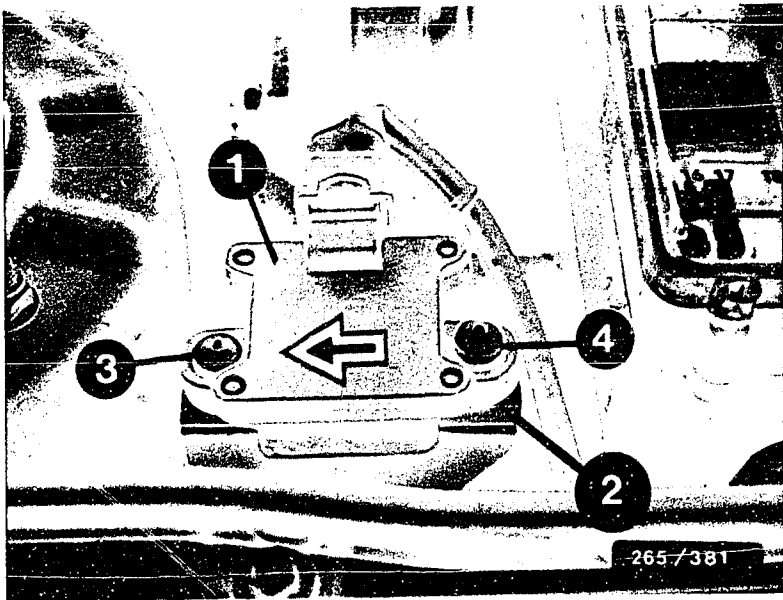
RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 4

Under test (measurement at the terminals)	Addition- al operation	Test specification (reading)	Possible causes of trouble
Acceleration sensor a _L (term.16)	Ignition on	LED a _L lights up	<ul style="list-style-type: none">* Check acceleration sensor: resistance value: <100 Ω Exchange sensor: drill out shear-head screw. Adjust sensor with special tool Pay attention to installation position. Use new shear-head screws.* Check lead from acceleration sensor to ABS controller term.16.* Check lead from controller term.1 to acceleration sensor.

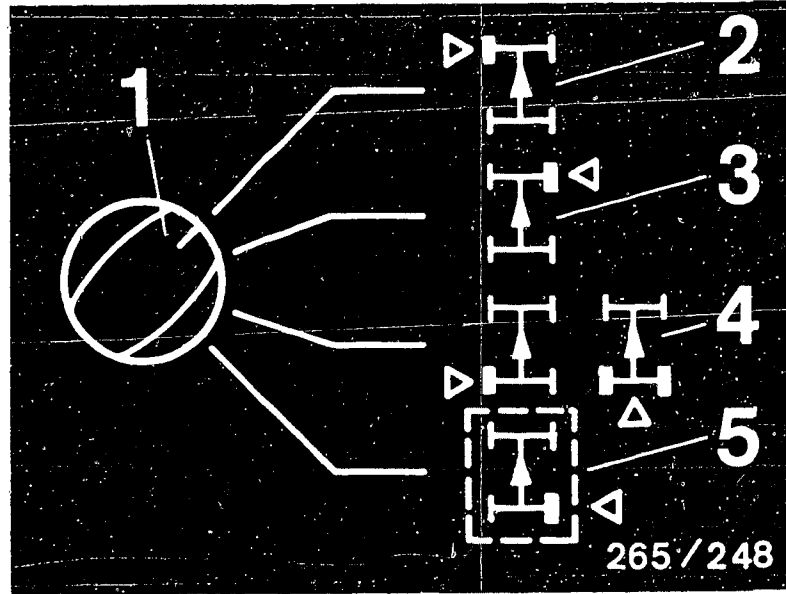
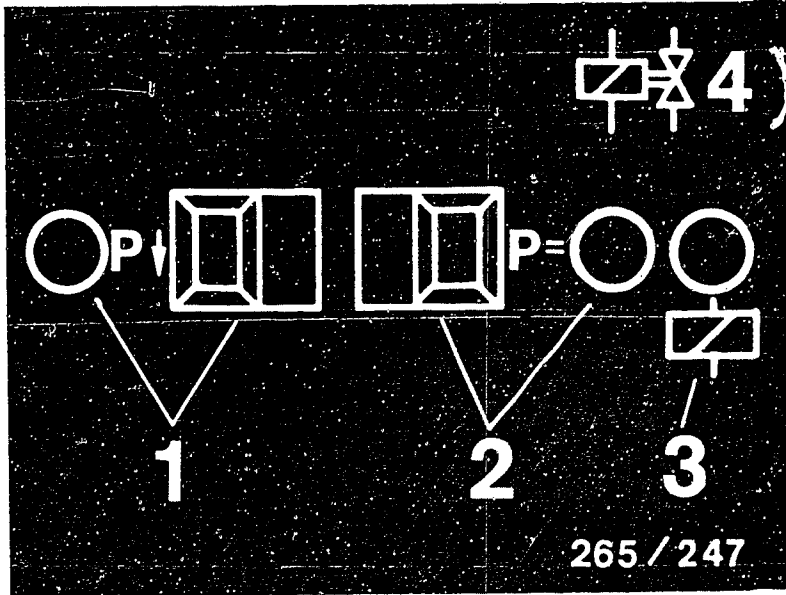


- 1 = Acceleration sensor
 - 2 = Chock
 - 3 = Shear-head screw, front
 - 4 = Shear-head screw, rear
- Arrow = Forward direction of travel



RAPID DIAGNOSIS CHART (CONTINUED)
Program-selector-switch position 5 (3-channel hydraulic modulator)

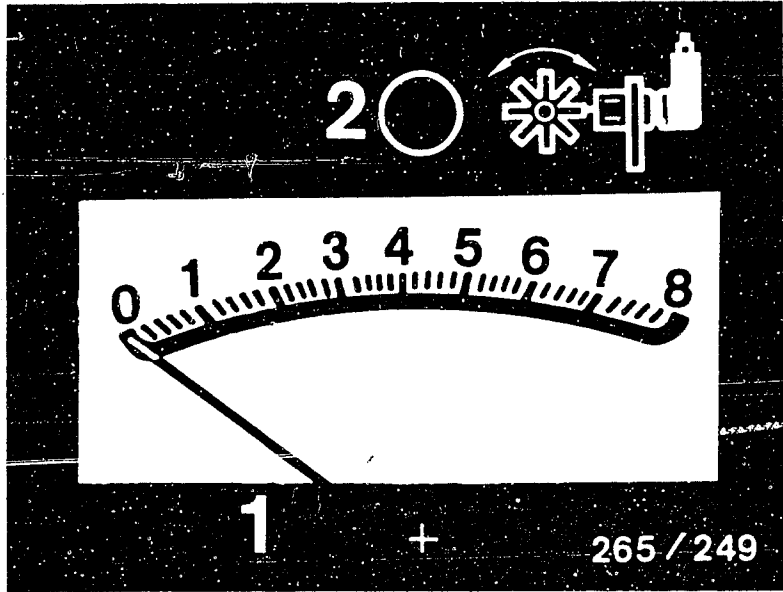
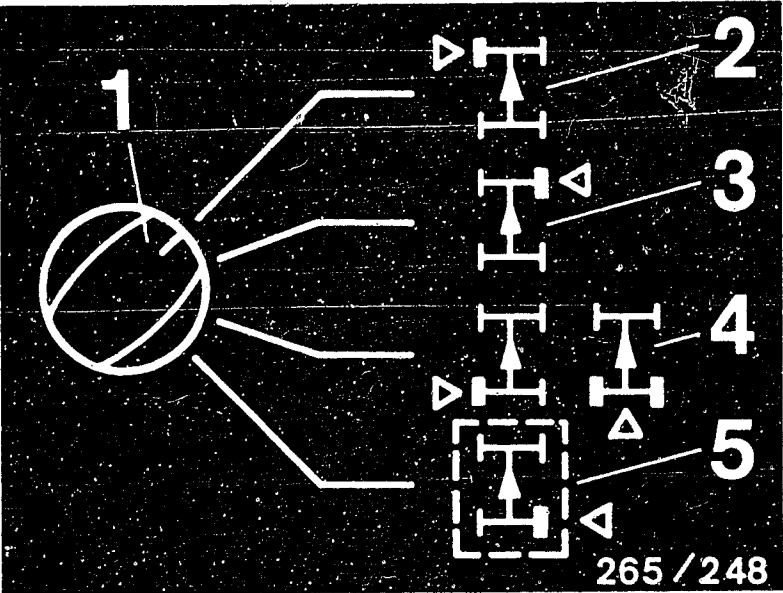
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	* Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running * Valve relay (make contact) defective * Break in line from valve relay term. 87 to batt. +ve * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push-button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correctly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.— Wheel, rear right: term.— Rear axle: term.18 * Hydraulic modulator defective
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.4 and term.0,6...1,6</p> <p>Wheel, front right: term.11 and term.21</p> <p>Wheel, rear left: term.8 and term.9</p> <p>Wheel, rear right: term.24 and term.26)</p>	<p>Chock up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turnable by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1.Smallest reading larger 1,6 divisions</p> <p>2.Permissible fluctu- ation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Break in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance Front axle: 0,6...1,6 k Ω Rear axle: 22 k Ω</p> <p>*Air gap between wheel-speed sensor and ring gear too wide</p> <p>*Ring gear defective or loose</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 48 teeth Rear axle: 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Reading appears, LED 2 does not light up: loose contact in wheel- speed-sensor lead.</p>



Continue test with next coordinate.

Check engine-drag-torque control:

The engine speed and ignition are influenced by the Motronic (as of M1.1 with 55-pin plug).

Switch off ignition and disconnect ABS controller and throttle-valve-switch plug.

Run engine at approx. 3000 min⁻¹ without loading.

Using suitable lead, bridge term. 2 and term. 18 in the throttle-valve-switch plug (this simulates closed idle contact).

Engine "hunts".

Afterwards, bridge term. 1 (batt. +ve) and term. 3 on controller plug.

Set value: engine speed increases again to 3000 min⁻¹, i.e. the overrun cut-off is raised.

Operation not O.K.:

+Check lead from ABS controller plug term. 3 to Motronic control-unit plug term. 50 over engine plug term. 17.

+Check lead from throttle-valve-switch plug term. 2 and term. 18 to Motronic control-unit plug term. 52 and ground.

+Motronic control unit defective..

Clutch switch:

*Ignition off. Disconnect controller plug.

Connect voltmeter to term. 33 (+) and ground.

Ignition on and depress brake pedal:

Voltage must be greater than 10 V.

Fully depress clutch: voltage 0 V.

If operation not O.K., check switch and leads; adjust switch.

Final check: take for road test driving faster than 30 km/h for at least 20 seconds, and at at least 50 km/h for at least 3 seconds. The warning lamp must not light up.

TEST SPECIFICATIONS

Wheel-speed sensor

* Winding resistance at ambient temperature (-10°C...+120°C) for

front axle:

600...1600 Ω

rear axle:

600...1600 Ω

Hydraulic-modulator solenoid-operated valves

* Winding resistance at ambient temperature (-10°C...+120°C):

0,7...1,7 Ω

Air gap:

0,8 ± 0,5 mm

Tightening torque for

* Fastening screws of wheel-speed sensor:

> 8 Nm

* Brake-line connections on hydraulic modulator:

12...16 Nm

Number of teeth

* Front axle:

48 teeth

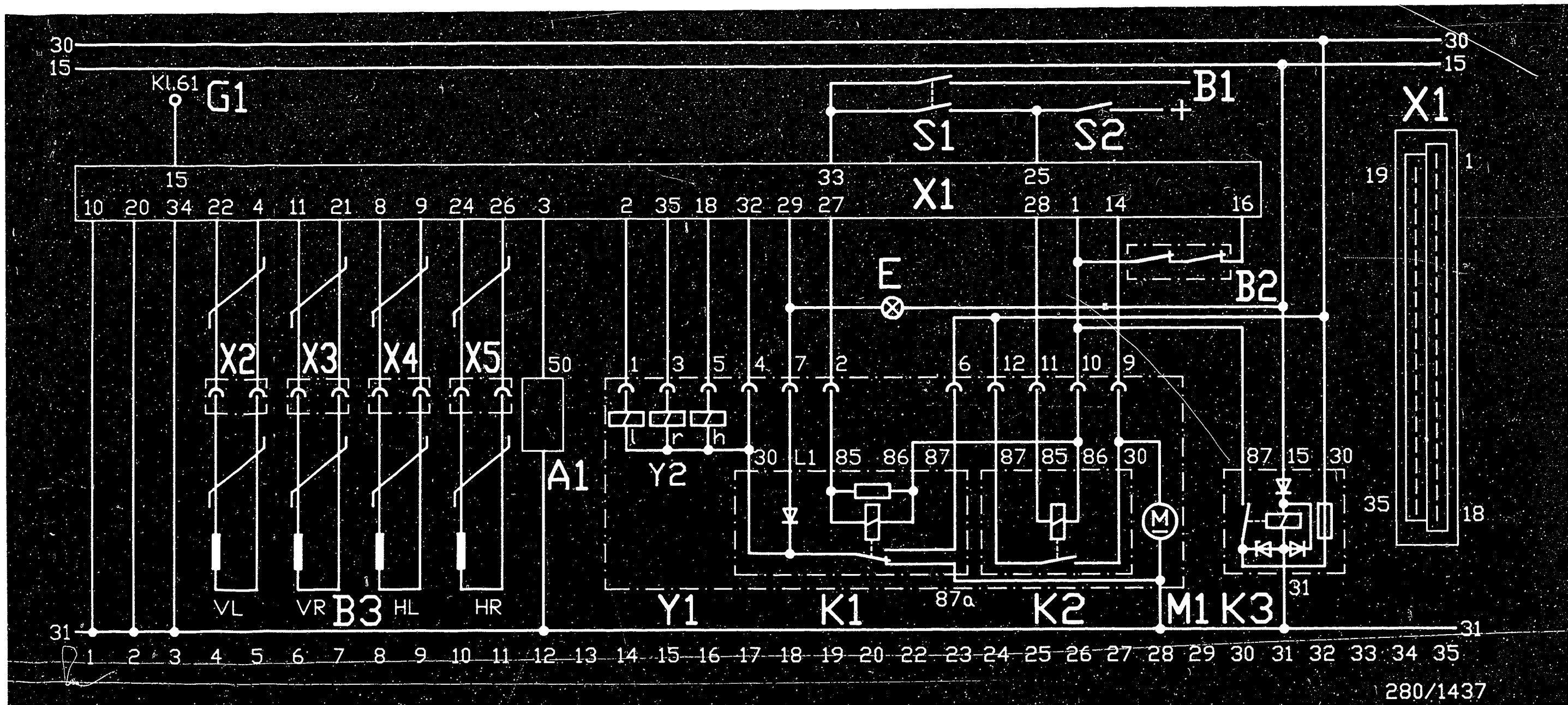
* Rear axle:

48 teeth

Acceleration sensor

* Contacts closed in horizontal position:

< 100 Ω



A1 = Motronic control unit (55-pin)

B1 = Tempomat

B2 = Acceleration sensor

B3 = Wheel-speed sensor

E = ABS warning lamp

G1 = To alternator

K1 = Valve relay as of 8.87

K2 = Motor relay

K3 = Overvoltage-protection relay

M1 = Return-supply-pump motor

S1 = Clutch switch

S2 = Stop-lamp switch

X1 = Controller plug (35-pin)

X2...X5 = Multiple butt connector

Y1 = Hydraulic modulator

Y2 = Solenoid-operated valves

VL = l = Front left

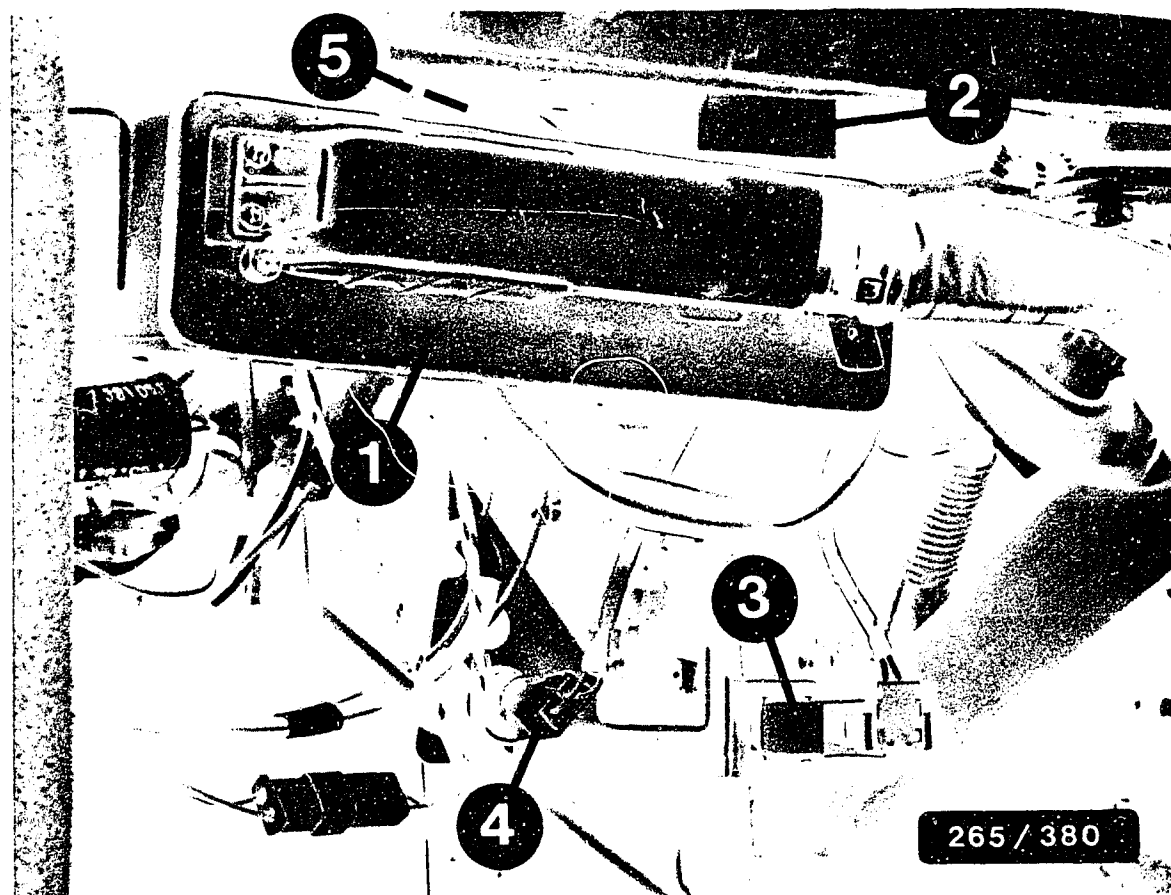
VR = r = Front right

HA = h = Rear axle

HL = Rear left

HR = Rear right

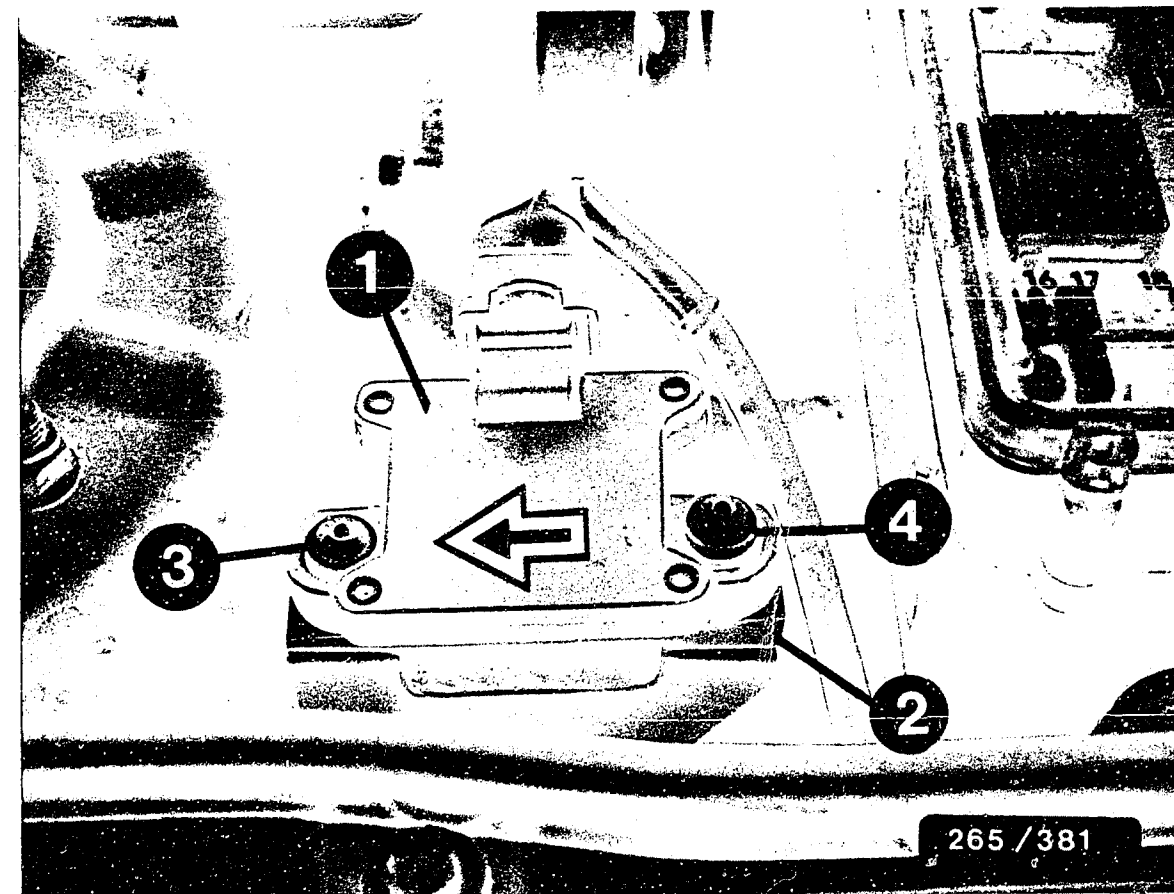
ELECTRICAL TERMINAL DIAGRAM 1.87->



INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

- * Controller (Item. 1):
to the left of the steering column behind the footwell panelling.
- * Overvoltage-protection relay (Item 2):
on the right above the controller.
- * Stop-lamp switch (Item. 3):
on the brake pedal.
- * Clutch switch (Item 4):
on the clutch pedal.
- * Ground terminal (Item 5) for ABS:
behind the controller.
- * ABS warning lamp: in the instrument panel.
- * Battery: in the luggage compartment on the right.



- 1 = Acceleration sensor
- 2 = Chock
- 3 = Shear-head screw, front
- 4 = Shear-head screw, rear
- Arrow = Forward direction of travel

INSTALLATION POSITION OF COMPONENTS (Continued)

Exchange accelerator sensor:
drill out shear-head screws. Adjust sensor using special tool. Pay attention to direction of installation. Use new shear-head screws.

- * Wheel-speed sensors, front axle:
left and right in the steering knuckles.
Do not mix up the left-hand and the right-hand wheel-speed sensors when installing.
- * Wheel-speed sensors, rear axle:
left and right near to the brake calipers.
- * Ground cables for pump motor and valve relay (->8.87):
in the engine compartment on the left-hand side on the bodywork.

INSTALLATION POSITION OF COMPONENTS (Continued)

* Hydraulic modulator:

In the engine compartment behind the left-hand headlamp.

The hydraulic modulator must not be repaired, but be exchanged as a complete unit.

E x c e p t i o n : The relays may be changed.

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions : OPE-5009
BOSCH system : Motronic ML 4.1
Make of vehicle : OPEL
Basic microcard : PKW-050

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Installation position of components, notes on removal and installation.....	23

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

OPEL Omega 3000 (-> 3.87) and

OPEL Senator B (-> 9.87)

with 3.0 l / 6-cylinder engine,
engine type CIH, C 30 LE with
catalytic converter.

- * Motronic ML 4.1 with self-diagnosis
- * One common sensor for engine speed and reference mark
- * Single-winding rotary actuator
- * Lambda closed-loop control
- * Variant encoding for octane-rating adaptation and transmission
- * Vehicles with electronic transmission control:
on shifting gear, the electronic transmission control causes a brief adjustment of the spark-advance angle via the Motronic control unit.
This reduces bucking as the gears are shifted.
- * Ignition distributor is used only as a high-voltage distributor.
Adjustment is required.

Variant encoding

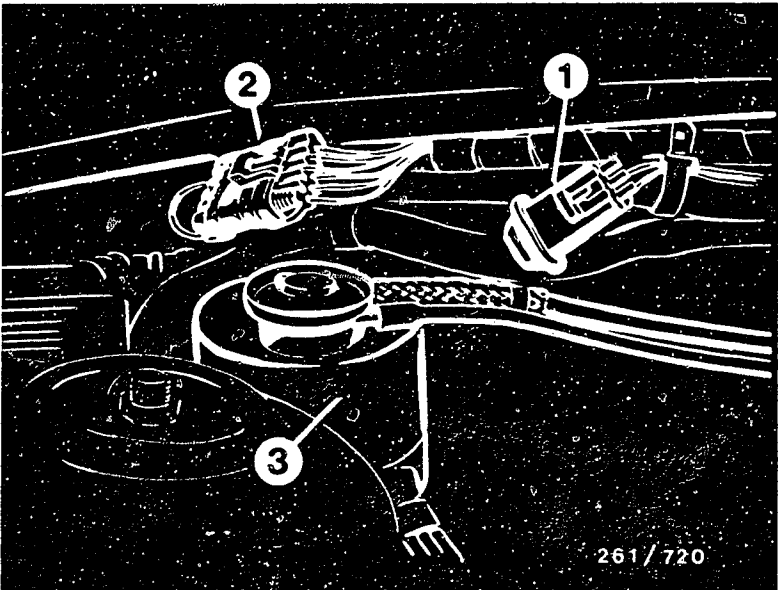
Octane-rating adaptation with encoding plug (black plug).

Octane rating	Resistance at term. 15 for 3 l engine, 115 kW with catalytic convert. with closed-loop cont.	
91 RON *)	0 Ω	1)
	Infinity Ω	2)
	750 Ω	2)3)4)
95 RON	220 Ω	1)
	1200 Ω	3)
	2200 Ω	2)
	4700 Ω	2)3)
	—	

*) 91 RON = unleaded regular gasoline (used only in case of emergency if no 95 RON gasoline is available).

95 RON = unleaded premium gasoline

- 1) Basic value
- 2) Idle speed is raised by 100 min⁻¹.
- 3) Acceleration enrichment is enriched.
- 4) Spark advance amounts to -5.25 ° crankshaft (retardation) throughout the whole characteristic-map range.



1 = Octane-rating encoding plug
2 = Diagnostic plug
3 = Activated-carbon canister

Vehicles with catalytic converter: term. 27 infinity Ω (open)

Vehicles without catalytic converter: term. 27 zero Ω (to ground)

Vehicles with manually shifted transmission:
term. 10 infinity Ω (open)
term. 28 zero Ω (to ground)

Vehicles with automatic transmission:
term. 10 zero Ω (to ground)
term. 28 to selection-lever position P and N: zero Ω (via selection lever to ground).
In this way, idle speed is dropped in order to prevent driving off. In all other selection-lever positions, term. 28 is open (0 Ω)

Vehicles with air conditioner:
term. 29 to switch for defroster lever (air-conditioner readiness for operation).
Term. 32 to switch for compressor.

Vehicles with distance-travel frequency sensor (speedometer signal):
term. 26 connected to distance-travel frequency sensor.
Distance-travel frequency sensor is installed only in conjunction with on-board computer, LCD instrument or electronic speedometer.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection while testing the compression!
Disconnect the Motronic relay.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

- Starting motor operates, but engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Rough idling (engine speed, exhaust gas).
- Poor throttle response, flat spot during acceleration.
- Engine misfiring (ignition, injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on (dieseling).
- Engine pinging/knocking.
- Engine overheating.
- Fault lamp.

Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*										Voltage at control unit
*										Sensor
*	*			*	*					Fuel pressure
*	*			*	*					Solenoid-operated injection valves
	*	*								Idle contact
				*						Full-load contact
	*	*	*	*	*	*				Air-flow sensor
	*	*	*							Idle actuator
*	*	*	*							Air-induction system
	*									Idle speed
*	*		*	*						Ignition coil
*	*	*	*	*	*					Primary signal
	*	*	*	*	*	*				Secondary pattern
*	*	*	*		*	*	*	*	*	Ignition point
	*									Exhaust gas
	*									Overrun cut-off
	*	*	*							Interference-suppression resistors
	*	*	*							Noise test
				*						Interference

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (symptoms of trouble)

- Starting motor operates, but engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Rough idling (engine speed, exhaust gas).
- Poor throttle response, flat spot during acceleration.
- Engine misfiring (ignition, fuel injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on (dieseling).
- Engine pinging/knocking.
- Engine overheating.
- Fault lamp.

Cause (component fault)										
				*						Throttle valve
				*						Fuel delivery
	*	*	*							Tank vent
		*	*							Lambda closed-loop control
*	*	*	*	*	*	*	*	*	*	Motronic control unit
			*	*						Electronic transmission control

SELF-DIAGNOSIS TEST TABLE

Fault indication Flash code	Testing of components/function	Test instructions/Test conditions	Terminals	Set values
1 2	Control unit/flashing-code output OK	Flashing-code output does not operate if fault lamp, supply leads to fault lamp and to diagnostic plug, and the current supply to the control unit are defective. If everything is O.K., but no flashing code is output, the control unit is defective.	4, 17	—
1 3	Lambda sensor/voltage change	Break in lead to lambda sensor	24	—
1 4	Temperature sensor (engine)/short circuit to ground	Test temperature sensor and lead for short circuit to ground.	13	—
1 5	Temperature sensor (engine)/open circuit	Test temperature sensor and leads for open circuit. Temperature-sensor resistance : at +15...+30°C ; at approx. +80°C ;	13, ground	1450...3300 Ω 280...360 Ω
4 4	Lambda sensor/short circuit to ground	Test lead for short circuit to ground. Watch out for rubbed locations!	24	—
4 5	Lambda sensor/short circuit to battery voltage	Test lead for short circuit to battery voltage. Watch out for rubbed locations!	24	—
4 8	Supply voltage for control unit too low (with engine running)	Supply voltage: Test voltage drops at positive and ground terminals. Charge battery.	35(+), 5(-)	greater than 10 V
4 9	Supply voltage for control unit too high (with engine running)	Supply voltage: Test generator regulator.	35(+), 5(-)	less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flash code	Testing of components/function	Test instructions/Test conditions	Terminals	Set values
5 1	Control unit/digital component	Control unit defective	—	—
6 5	Idle potentiometer for CO adjustment/voltage too low	Measure resistance of potentiometer. Test lead for short circuit to ground. Term. 9 interrupted. Term. 6 and term. 9 bridged.	30	Measure resistance at air-flow sensor between term. 1 and term 4: Minimum 0...30 Ω Maximum: The value measured between term. 3 and term. 4 may be up to 30 Ω less. (Set value between term. 3 and term. 4: 300 ...550 Ω)
6 6	Idle potentiometer for CO adjustment/voltage too high	Measure resistance of potentiometer. Test potentiometer and leads for open circuits and short circuits to battery voltage. If term. 6 interrupted, fault code 7 4 comes as well.	30	
6 7	Throttle-valve switch/idle contact	Fault: idle contact permanently closed. Idle contact closed in rest position: Actuate throttle valve slightly:	2, ground	0 Ω infinity Ω
6 9	Temperature sensor (air)/short circuit to ground	Test temperature sensor and lead for short circuit to ground.	22	—
7 1	Temperature sensor (air)/open circuit	Test temperature sensor and leads for open circuit. Temperature-sensor resistance: at +15°C...+30°C:	22,6(-)	1450...3300 Ω
7 2	Throttle-valve switch/full-load contact	Fault: full-load contact permanently closed. Fault lamp lights up only intermittently in overrun. Full-load with contact closed in full-throttle position: Release accelerator pedal slightly:	3	0 Ω infinity Ω

SELF-DIAGNOSIS TABLE (CONTINUED)

Fault indication Flash code	Testing of components/function	Test instructions/Test conditions	Terminals	Set values
7 3	Air-flow sensor/short circuit to ground	Test lead to term. 7 for short circuit to ground. Break in lead to term. 7 and term. 9, or term. 6 and term. 9 bridged.	6,7,9	—
7 4	Air-flow sensor/open circuit	Test lead to term. 6 for open circuit. (Fault code 6 6 also appears). Test leads to term. 6 and term. 7 for short circuit to positive (5 V or battery positive). Test resistances of air-flow sensor: : between term. 6 and term. 7 (deflect air-flow sensor flap): between term. 6 and term. 9 :	6(-), 7	8...2500 Ω 300...550 Ω
7 5	Transmission switch/short circuit to ground	Fault: switch permanently closed. Test lead for short circuit to ground.	8	—

TEST SPECIFICATIONS

Pressure regulator	
* Fuel pressure	2,8...3,2 bar
Electric fuel pump	
* Fuel delivery (measured in return line)	at least 850 cm ³ /30s
Supply voltage (under load):	at least 12 V
Temperature sensor (air)	
* Internal electrical resistance measured at air-flow sensor between term. 4 and term. 5 at ambient temperature (+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine), plug color, blue.	
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	1450...3300 Ω
with engine at normal operating temperature (approx. + 80° C):	280....360 Ω
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	14,5...17,5 Ω
Air-flow sensor	
* Internal electrical resistance between:	
term.2 and term.4 :	8...2500 Ω (1)
term.3 and term.4 :	300...550 Ω
term.1 and term.4 (CO potentiometer):	
Minimum	0....30 Ω
Maximum: the actual value measured between term.3 and term.4 is permitted to be up to 30 Ω less.	
(1) Deflect air-flow sensor flap slowly as far as it will go. Resistance fluctuates between the terminals of the potentiometer.	

TEST SPECIFICATIONS (CONTINUED)

Engine-speed sensor and reference-mark sensor	
* Internal electrical resistance at ambient temperature (+15°C...+30°C):	400...800 Ω
* Air gap:	0,8 ±0,5 mm
Throttle-valve switch	
* Resistance value of idle contact term.2 and term.18):	0 Ω
* Resistance value of full-load contact (term.3 and term.18)	0 Ω
Pressure sensor (altitude sensor)	
* Total resistance between term.3(+) and term.2(-) :	2300...2500 Ω
* Resistance between wiper term.1(S) and term.2(-) :	400...2300 Ω
Test specification is altitude-dependent	
Idle actuator	
* Internal electrical resistance at +15°...+30°C :	approx. 8 Ω
Lambda sensor	
* Resistance value of heater winding	1...15 Ω
Ignition coil	
* Primary resistance	approx. 0 Ω
* Secondary resistance	5000...7200 Ω
Interference-suppression resistors	
* High-voltage distributor rotor: 1 k Ω	
The secondary side of the ignition system must be interference-suppressed with at least 5k Ω total resistance. High-voltage resistance cables are installed as standard.	

TEST SPECIFICATIONS (CONTINUED)

Idle test:

Engine at normal operating temperature,
switch off loads.

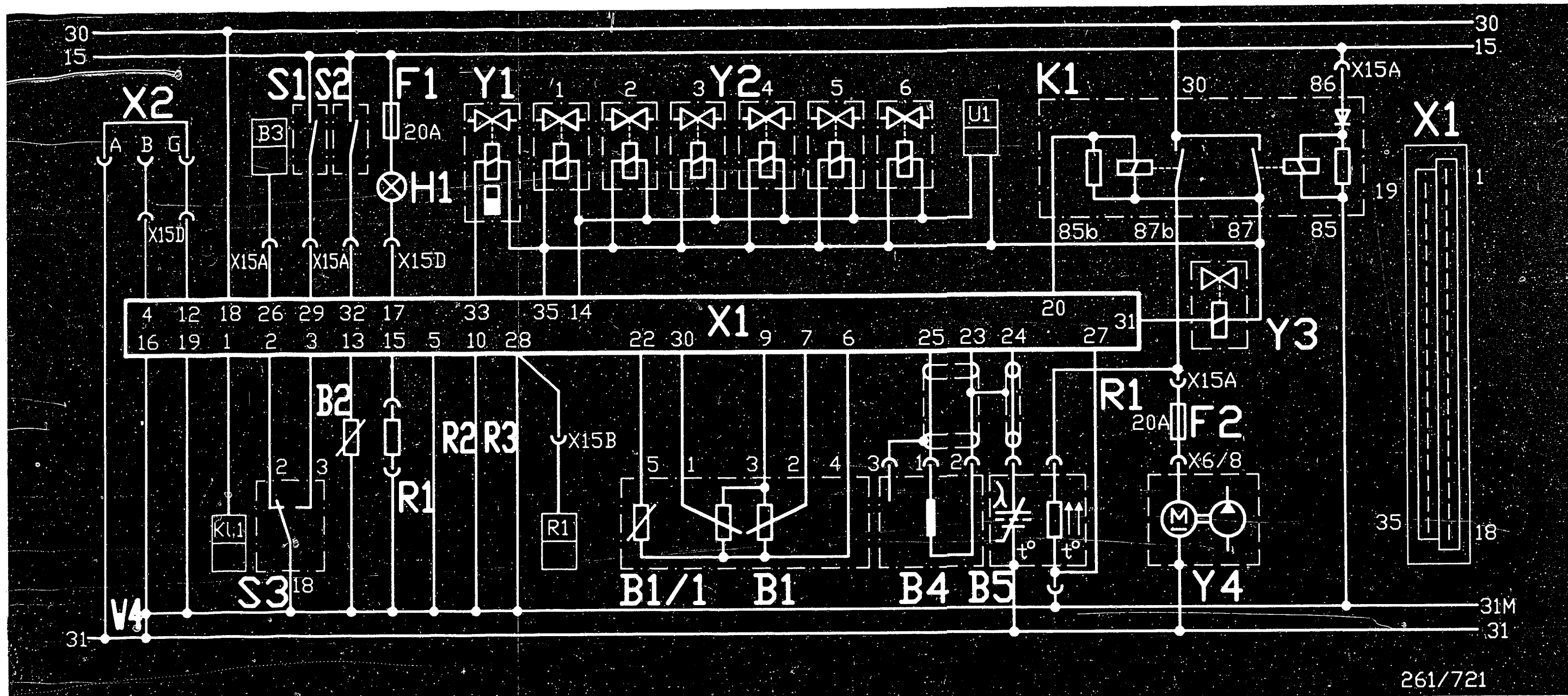
- * Idle speed: $600 \pm 40 \text{ min}^{-1}$ +)
- * Spark-advance angle: $10 \pm 5^\circ$ crankshaft +)

Automatic transmission to N or P

+) Attention! The basic values stated may deviate due
to variant encoding. Pay attention to table in
"Special Features" section.

See equipment and Autodata microcards for
settings for valve clearance and other engine-
related data.

For production reasons:
continued on the following
coordinate.

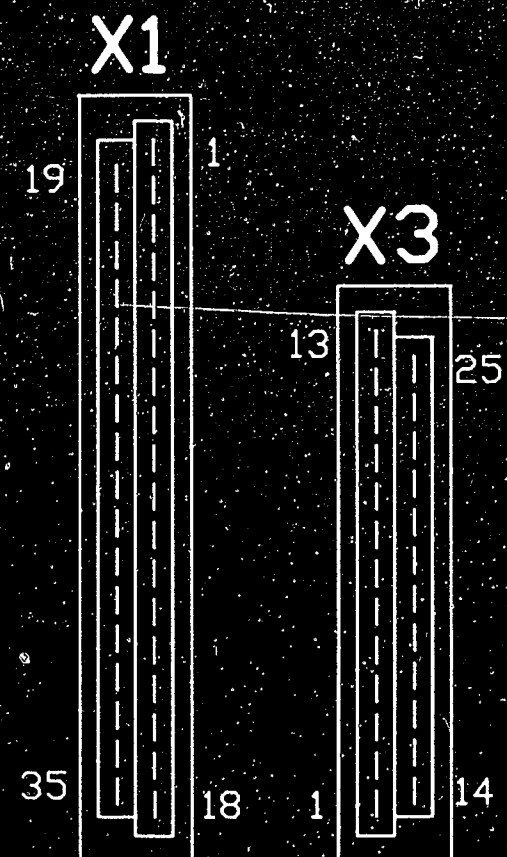
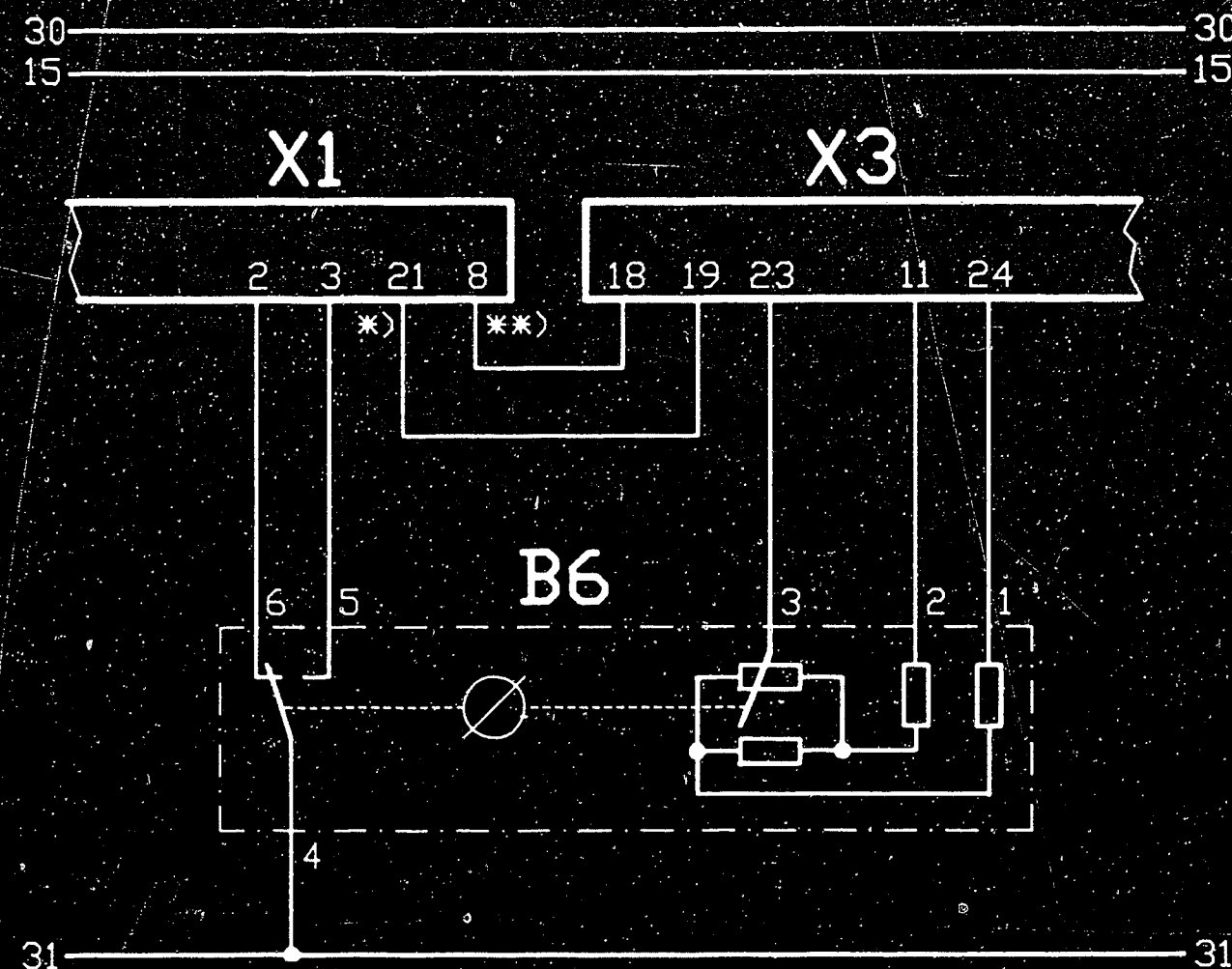


ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
 B1/1 = Temperature sensor (air)
 B2 = Temperature sensor (engine)
 B3 = Distance travelled sensor
 B4 = Lambda sensor
 B5 = Eng.-speed/ref.-mark sensor
 F1, F2 = Fuse 20A

H1 = Fault lamp
 K1 = Motronic relay
 Term. 1 = Ignition coil term. 1
 R1 = See variant coding
 R2 = For automatic transm. only
 R3 = For man. shifted transm. only
 S1 = Switch, compressor
 S2 = Air conditioner
 S3 = Throttle-valve switch

U1 = On board computer
 W4 = Ground strap, engine
 X1 = Motronic control-unit plug
 X2 = Diagnostic plug
 Y1 = Injection valve
 Y2 = Tank bleeder valve
 Y3 = Idle actuator
 Y4 = Electric fuel pump



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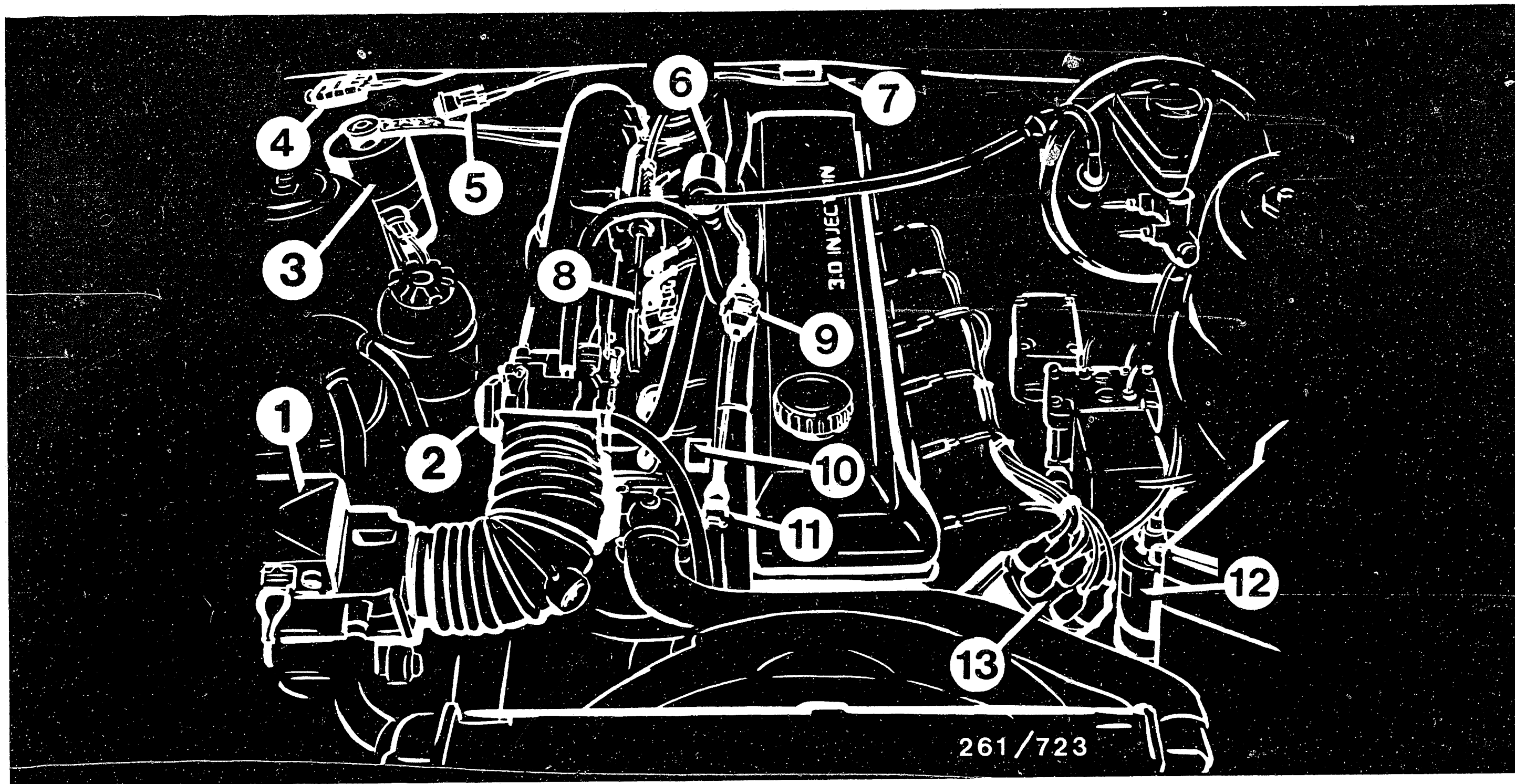
B6 = Throttle-valve switch
with potentiometer for
electronic transmission
control

X1 = Motronic control-unit plug

X3 = Transmission control-unit plug

*) = Output for engine speed
**) = Input for engine action

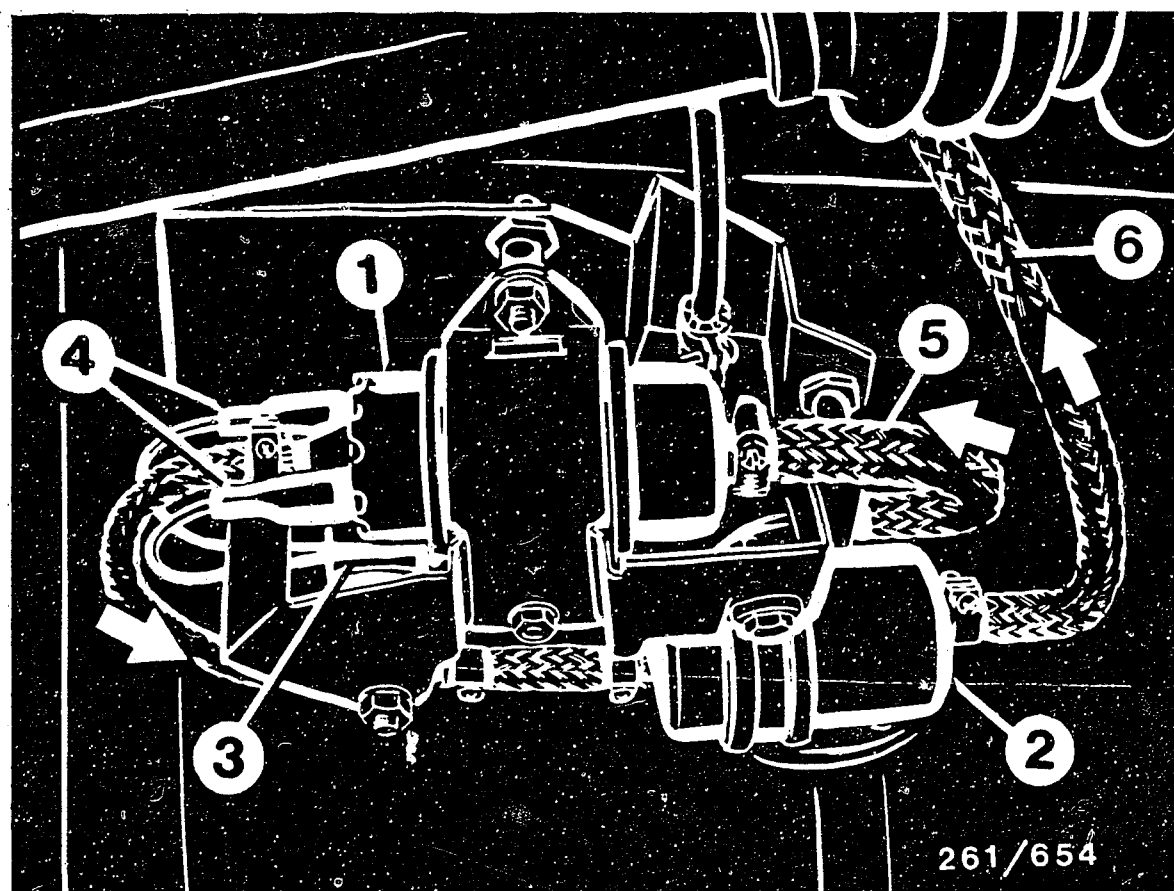
ELECTRICAL TERMINAL DIAGRAM (CONTINUED)
(Deviations for vehicles with electronic transmission control)



- 1 = Air-flow sensor
- 2 = Throttle-valve switch
- 3 = Activated-carbon canister
- 4 = Diagnostic plug
- 5 = Octane-rating encoding plug
- 6 = Rotary actuator

- 7 = Lambda-sensor plug-in connection
- 8 = Injection valves
- 9 = Engine-speed-sensor plug-in connection
- 10 = Tank-ventilation valve
- 11 = Temperature sensor (engine)
- 12 = Ignition coil
- 13 = High-voltage distributor

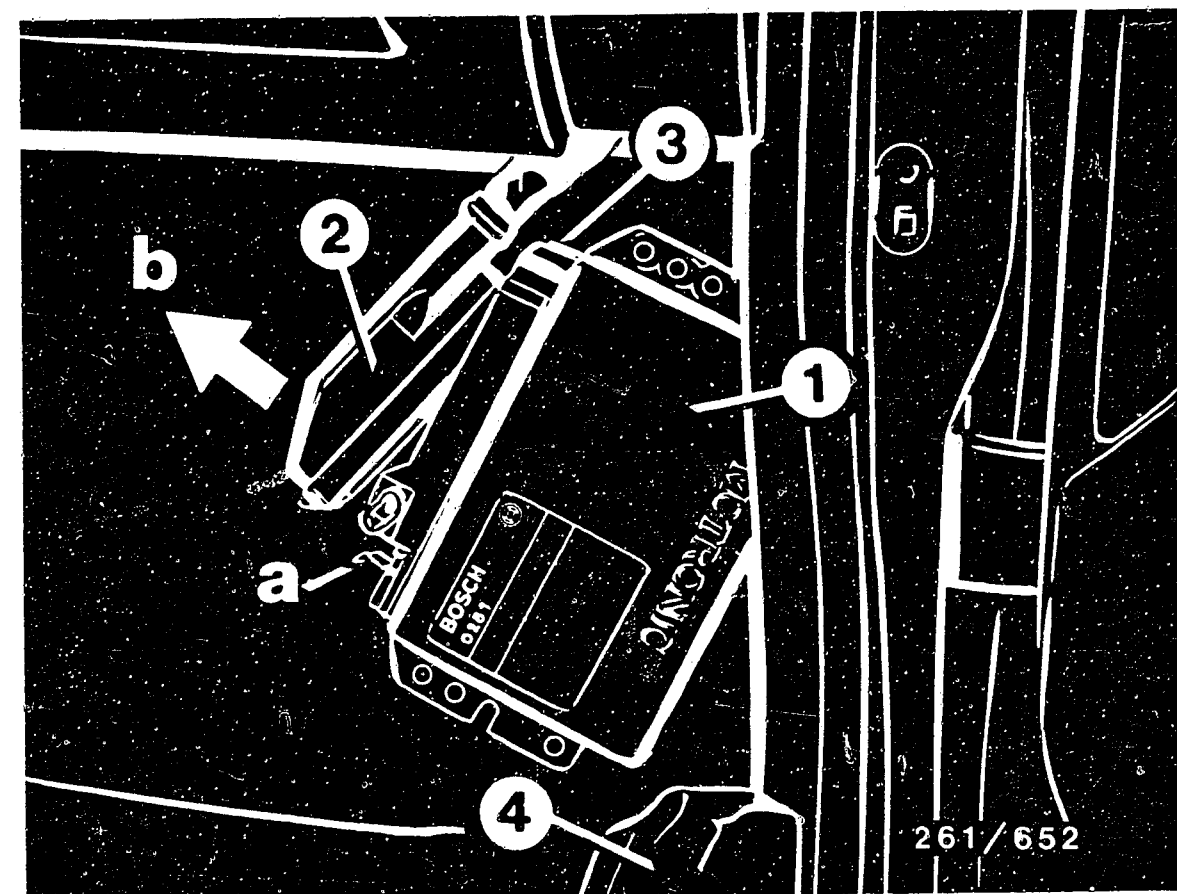
INSTALLATION POSITION OF COMPONENTS



- 1 = Electric fuel pump
- 2 = Fuel filter
- 3 = Pressure damper
- 4 = Electrical connections

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Electric fuel pump and fuel filter:
in front of the fuel tank.
- * Ground terminal:
In engine compartment at front on left-hand side on the bodywork next to the battery.
- * Diagnostic plug:
In engine compartment on right-hand side on the firewall.
- * Octane-rating encoding plug:
In engine compartment on right-hand side of the firewall.

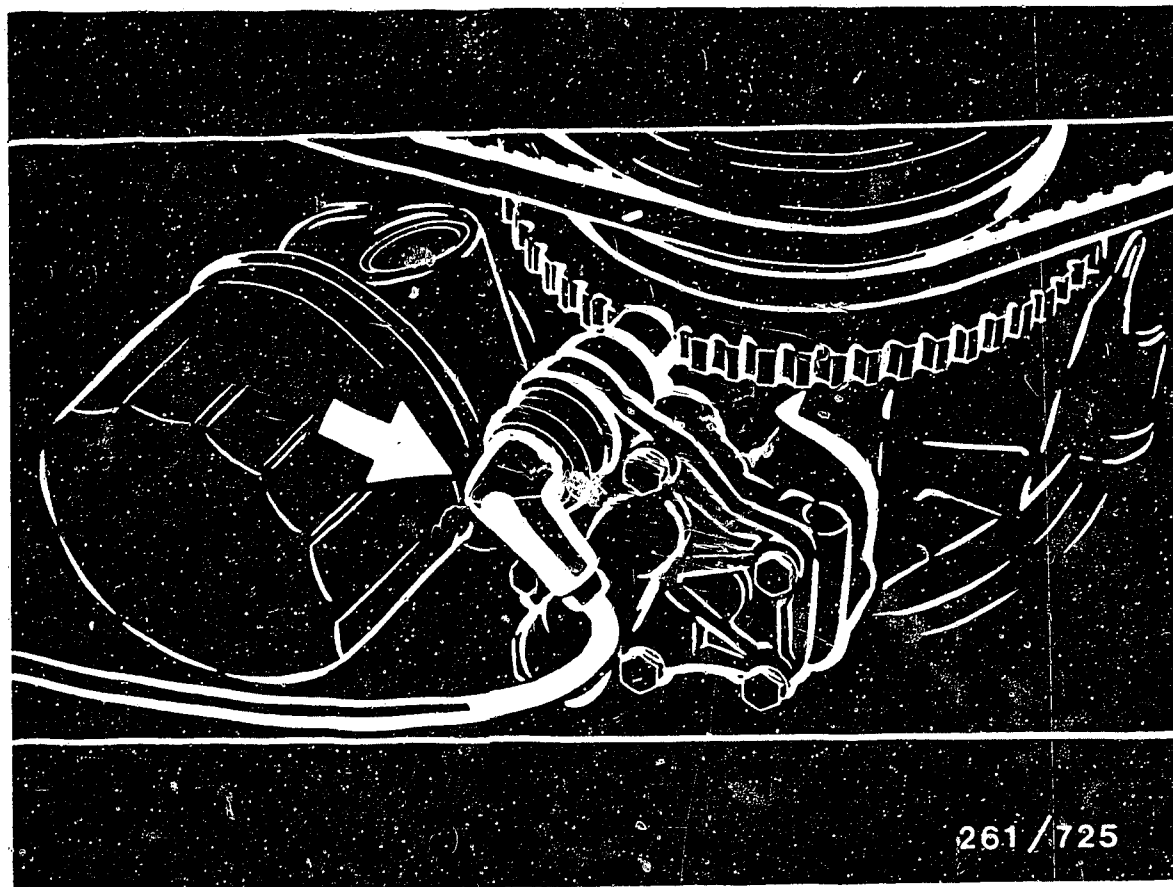


- 1 = Control unit
- 2 = Plug
- 3 = Mechanical encoding with lug
- 4 = Covering over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "right" and "left" always refer to the forward direction of travel.

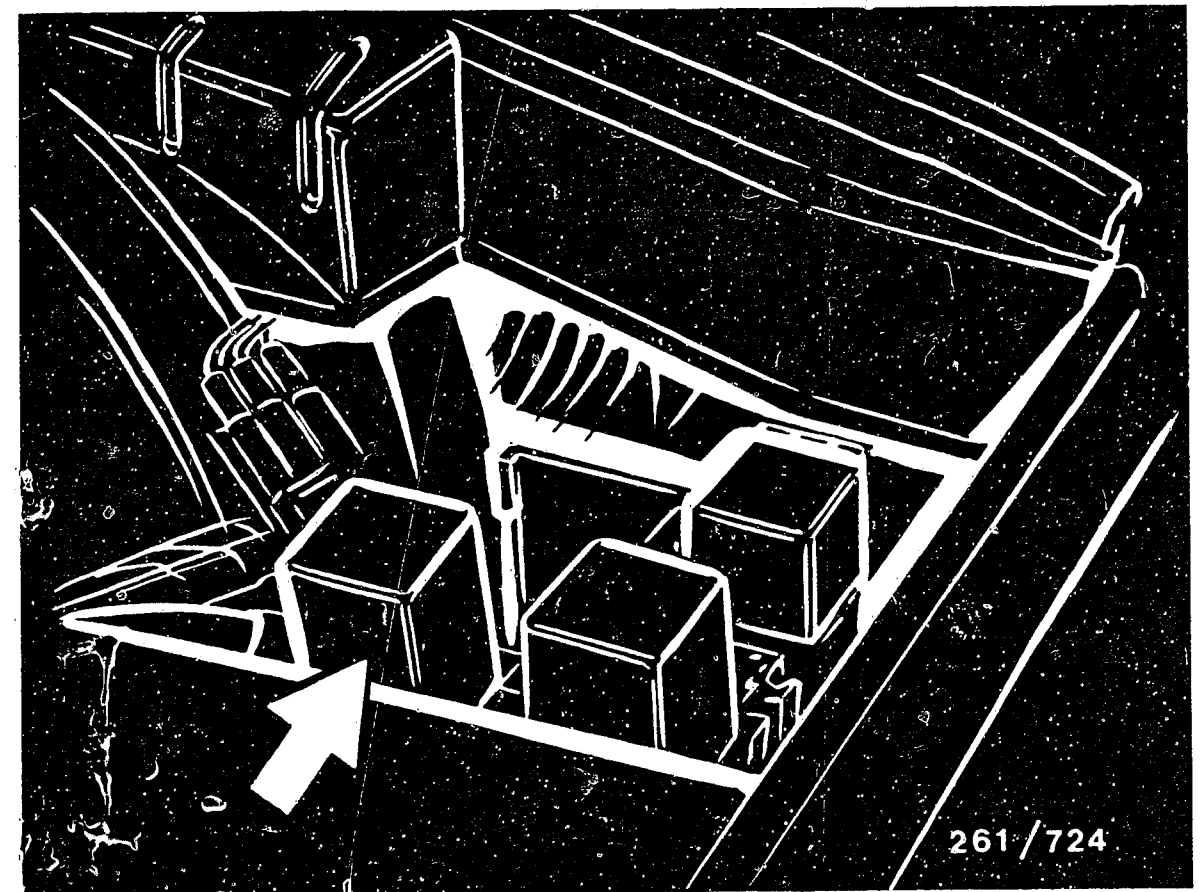
- * Control unit:
In passenger-side footwell on the right. Slightly lift up rubber strip and cover on door sill. Lift up floor carpet to one side and remove control-unit cover. Unscrew control unit. Unlatch plug (a), fold back (arrow b) and unhook (Item 3).
- * Temperature sensor (engine):
On engine block at the front on the right, blue plug.



Arrow = Reference-mark / engine-speed sensor

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Reference-mark/engine-speed sensor:
On oil-pump housing next to oil filter
(accessible from below).
- * Lambda sensor:
In common exhaust pipe upstream of the
catalytic converters.
- * Fuses:
In instrument panel, bottom left.
Fuse box can be tilted open at its
underside.
- * Temperature sensor (air):
In air-flow sensor



Arrow = Motronic relay

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Motronic relay:
In engine compartment on left-hand side in front of the
firewall.
- * Adjust ignition distributor:
Remove cap and protective cover from ignition
distributor.
Position cylinder 1 to ignition-timing
mark (pointer in inspection hole on cylinder
block points to ball in flywheel).
Center of ignition-distributor rotor must
point to marking on housing of cylinder 1.
If necessary, turn ignition-distributor housing;
to do this, loosen clamping strap.
- * Distance-travel frequency sensor:
At transmission output beneath vehicle.

Trouble-shooting instructions : AUD-5007

BOSCH system : Headlight vertical aim control (LWR)

Make of vehicle : AUDI

Basic microcard : AUD-515

TABLE OF CONTENTS

Section	Coordinate
Special features, safety, usage.....	02
Trouble-shooting chart.....	04
Rapid diagnosis chart for the headlight aiming device.....	05
Test specifications.....	07
Electrical terminal diagram.....	08
Installation position of components.....	09

SPECIAL FEATURES

- * This microcard contains the trouble-shooting instructions valid at the time of publishing for headlight vertical aim control for the following Audi models:

Audi 80 (04.87->)
- * The system is installed as optional equipment.
- * There is no knurled thumbscrew for basic adjustment fitted to the servomotor. Basic adjustment is performed at the adjusting screws of the headlights.
- * The system is similar to the headlight vertical aim control Audi 100/200 see SIS AUD-515

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to various causes/component faults. Detailed instructions for trouble-shooting must be taken from the basic instructions via the trouble-shooting chart.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

Finding individual test steps in the brief and basic instructions is made easier through the use of identical test-step numbers.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to prevent damage to the engine, control unit or ignition system, be sure to observe the safety and precautionary measures in the basic instructions.

* C A U T I O N !
High-performance ignition system.
Dangerous primary and secondary voltages.

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

For further precautionary measures, see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Headlight setting too high or too low.	
2. Headlight cannot be adjusted by LWR system.	
3. Light/dark boundary flickers during driving.	
Cause (component fault)	
*	Check basic headlight setting
* *	Headlight mechanically defective
*	Test fuse term. 56b
*	Servomotor with final control. element defective
*	Headlight vertical aim adjuster defective
*	Short circuit or open circuit in wiring harness
*	Mounting of servomotor defective

RAPID DIAGNOSIS CHART FOR TESTING WITH HEADLIGHT AIMING DEVICE 0 681 130 .. OR 0 684 100 ..

Conduct tests on both headlights in each case!

Test step	Set thumbwheel on vehicle to:	Set headlight aiming device to:	Set headlights to:	Reading on headlight aiming device
1	Position "0" (basic setting)	10 cm inclination	Light/dark boundary	—
2	Position "1"	Light/dark boundary	—	Between -16 cm and -28 cm
3	Position "2"	Light/dark boundary	—	Between -25 cm and -37 cm
4	Position "3"	Light/dark boundary	—	Between -42 cm and -54 cm
5	Position "0" (basic setting)	10 cm inclination	—	Between -15 cm and - 5 cm Setting is obtained again after short test drive (hysteresis toleranz)

TEST SPECIFICATIONS

Headlight vertical-aim setting device (hand detector):

Potentiometer total resistance
(term.1 to term.0,4): approx. 0,8 k Ω

Resistance in basic position "4,7"
(term.6,0 to term.7,0): approx. 9,2 Ω

Difference in resistance values between
position "0,9 \pm 0,3" and position "1,6 \pm 0,3"
(term.3,0 - 0,3 to term.10):

Hand detector "DA": min. Ω

Hand detector "DB": min. Ω

Hand detector "DC": min. Ω

Hand detector "DD": min. Ω

Hand detector "DE": min. Ω

Resistance must change constantly between
position " " and position " ".

Adjustment travel of positioning motors
between position " " and position " " of hand
detector:

Hand detector "DA": min. mm

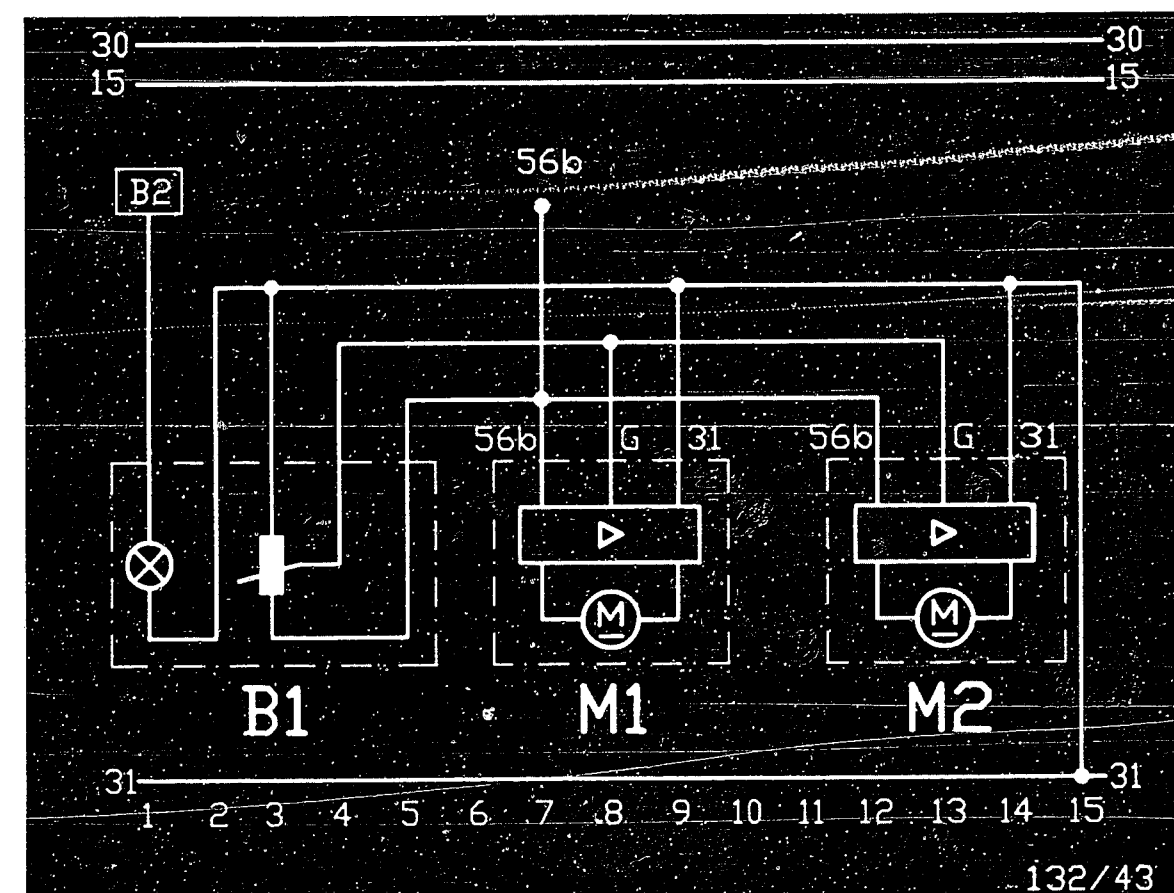
Hand detector "DB": min. mm

Hand detector "DC": min. mm

Hand detector "DD": min. mm

Hand detector "DE": min. mm

Basic headlight setting: H cm



ELECTRICAL TERMINAL DIAGRAM

B1 = Headlight aiming device with thumbwheel
(manual sender)

B2 = To brightness regulator, instrument
illumination

M1 = Servomotor with final controlling element, left

M2 = Servomotor with final controlling element, right

INSTALLATION POSITION OF COMPONENTS

The installation positions of components are similar to those described in the basic instructions.

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions : CIT-5003
BOSCH system : LE2—Jetronic
Make of vehicle : CITROEN
Basic microcard : OPE-502

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Test specifications.....	09
Electrical terminal diagram.....	11
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SPECIAL FEATURES

These breif instructions apply to the following vehicle model with 2.498-i/4-cyl. engine, valid at the time of compilation:

Citroen CX 25 GTi Turbo 2 05.86->

- * LE2-Jetronic with 25-pin control unit
0 280 000 352
- * Engine-speed triggering from TD terminal of ignition control unit
- * 5-pin air-flow sensor
- * 7-pin control relay
- * Starting control, i.e. additional quantity of injected fuel via all solenoid-operated injection valves.
- * Exhaust turbo-supercharger with charge cooler
- * Cutoff valve forms the direct connection between the air-flow sensor and intake manifold. It prevents fluttering of the air-flow sensor. The valve is activated by vacuum and opens at a vacuum of over 350 mbar.
- * For fuel pressure test, use pressure gauge and hoses of pressure measuring device.
- * Insert connecting part KDJE-P 100/14 between fuel inlet line.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 123

Test step	Switch V Ω	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
1	5 —	1 — 5	TD pulses from ignition control unit	Shift into neutral, start engine	TD pulses on oscilloscope
2	6 —	9 — 5 (+) (—)	Voltage from control relay term. 87	Shift into neutral, start engine	8...15 V
3	7 —	4 — 5 (+) (—)	Voltage from ignition and starting switch term. 15	Shift into neutral, start engine	8...15 V
4	 V	11	8 — 5 Resistor set in air-flow sensor	—	100...200 Ω
5	 V	12	7 — 5 Resistance of potentiometer in air-flow sensor	Deflect air-flow sensor flap as far as it will go	60...1000 Ω
6	 V	13	10 — 5 Resistance, temperature sensor (engine)	+15...+30°C: Approx. +80°C:	1,45...3,3 k Ω 280...360 Ω
7	 V	14	13 — 5 Frame connection of output stage		0...10 Ω

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
 Adapter lead: 1 684 463 123

Test step	Switch V	Ω	Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
8	 V	15	25 - 5	Frame connection of sensors		0...10 Ω
9	 V	16	2 - 9	Resistance of idle contact	Disconnect control-unit plug from ignition control unit Accelerator pedal in rest position : Slightly depress accelerator pedal :	0...10 Ω Infinity Ω
10	 V	17	3 - 9	Resistance of full-load contact	Connect control-unit plug of ignition control unit Accelerator pedal in rest position : Fully depress accelerator pedal :	Infinity Ω 0...10 Ω
11	 V	18	12 - 9	Resistance of shunt- connected solenoid- operated injection valves and series resistors	+15...+30°C : Approx. +80°C :	5,0...9,0 Ω 5,1...9,25 Ω

REMARK : Following components with respective connecting leads are not covered by the universal test adapter in the test:

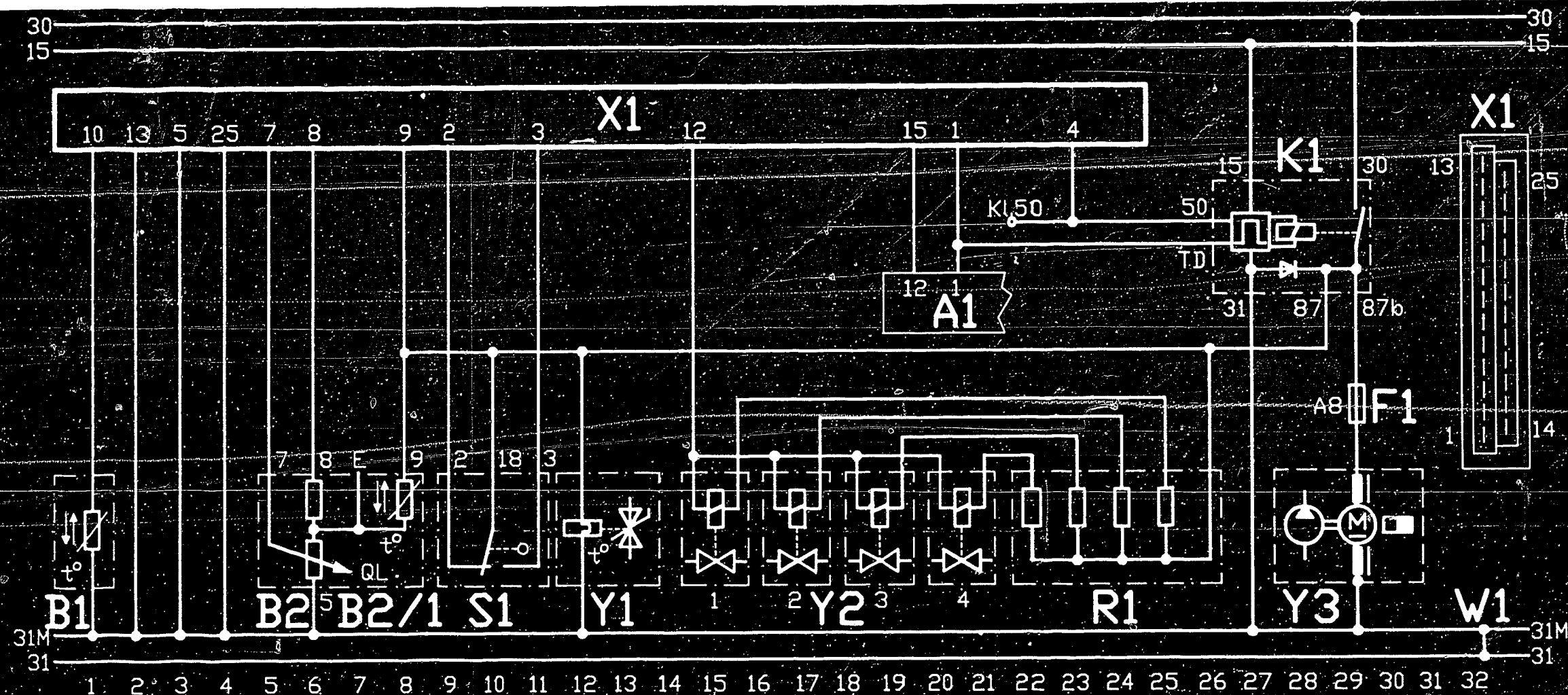
1. Auxiliary-air device: Positive lead from term. 87 of control relay, negative lead to engine ground.
2. Electric fuel pump: Positive lead from term. 87b of control unit (via pump fuse), negative lead to vehicle ground.

TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Fuel delivery at return:	At least 800 cm ³ /30 s
* Supply voltage under load:	At least 12 V
Pressure regulator	
* Fuel pressure with engine at standstill:	2,3...2,7 bar
at idle:	Approx. 0.5 bar lower
Fuel system, leakages	
* Fuel pressure after 20 mins. with engine at standstill:	At least 1.0 bar
Auxiliary-air device	
* Resistance value	35...70 Ω
Air-flow sensor	
* Resistance value between	
Term. 8 and term. 5:	340 ... 450 Ω
Term. 7 and term. 5:	60 ...1000 Ω 1)
Term. 9 and term. 5:	500 ... 760 Ω
Term. 8 and term. 9:	160 ... 300 Ω
1) (Fully deflect air-flow sensor flap)	
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature +15...+30°C:	1,45...3,3 k Ω
With engine at normal operating temperature approx. +80°C :	280...360 Ω

TEST SPECIFICATIONS (continued)

Component/function	Set values
Solenoid-operated injection valve	
* Electrical internal resistance at ambient temperature +15...+30°C:	2...3 Ω
* Leakages after 60 s:	there must be no drippin
Starting control	
* Voltage at injection valve on initiation of starting: after approx. 15 s:	greater than 1.5 V approx. 0.5 V
Idle-speed adjustment	
engine at op. temp., approx. +80°C	
* Idle speed:	750...850 min ⁻¹
CO adjustment	
engine at op. temp., aprox. +80°C	
* CO content:	0,8...1,5% by vol.
Series resistor	
* Electrical resistance	5...7 Ω
Exhaust turbo-supercharger	
* Charge-air pressure at 5000 min ⁻¹	max. 440 mbar
Cutoff valve	
* Vacuum greater than 350 mbar	open
For settings for ignition, valve clearance and other technical engine data, refer to equipment and autodata microcard.	



280/1449

A1 = Ignition control unit
 B1 = Temperature sensor (engine)
 B2 = Air-flow sensor
 B2/1 = Temperature sensor (intake air)
 F1 = Fuse (electric fuel pump)
 K1 = Control relay
 R1 = Series resistors

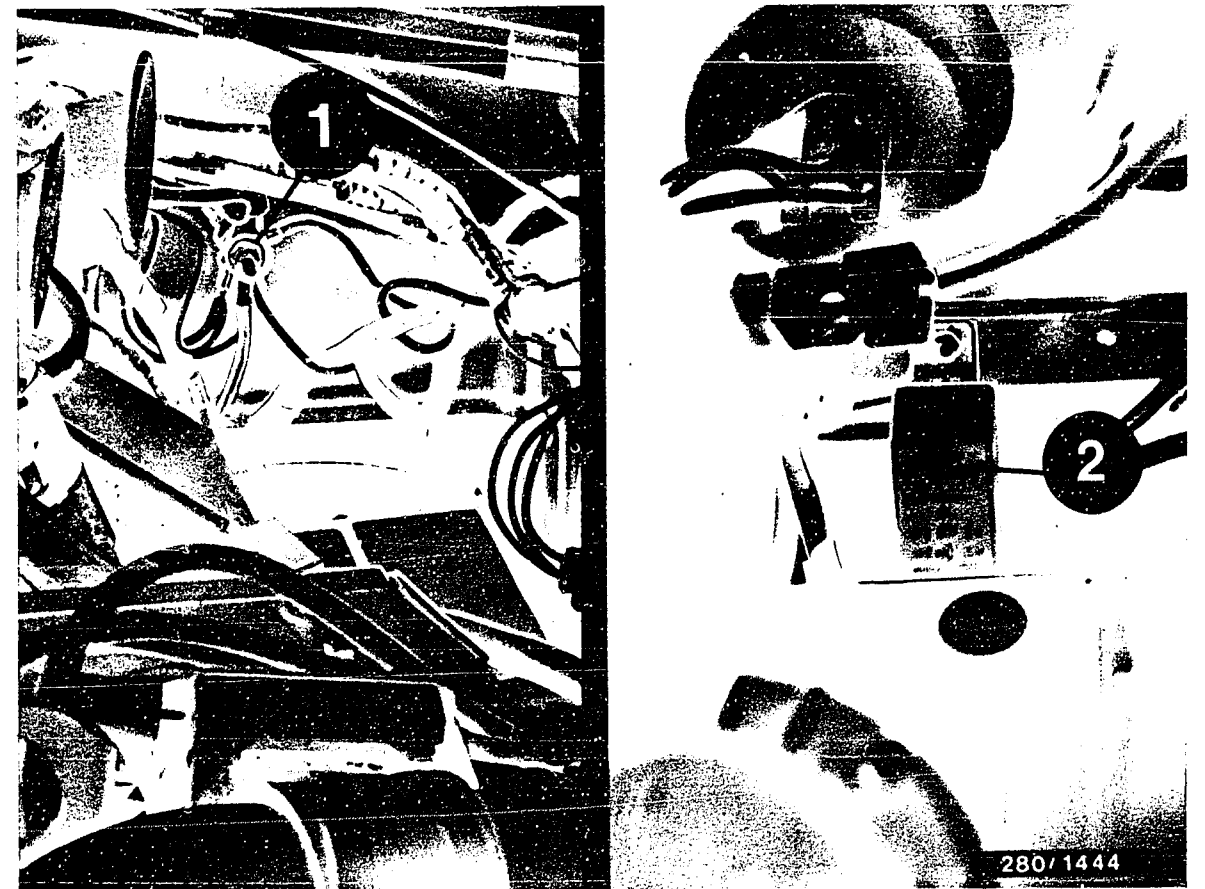
S1 = Throttle-valve switch
 W1 = Engine ground strap
 X1 = Control-unit plug
 Y1 = Auxiliary-air device
 Y2 = Solenoid-operated injection valves
 Y3 = Electric fuel pump

ELECTRICAL TERMINAL DIAGRAM

K11

K12

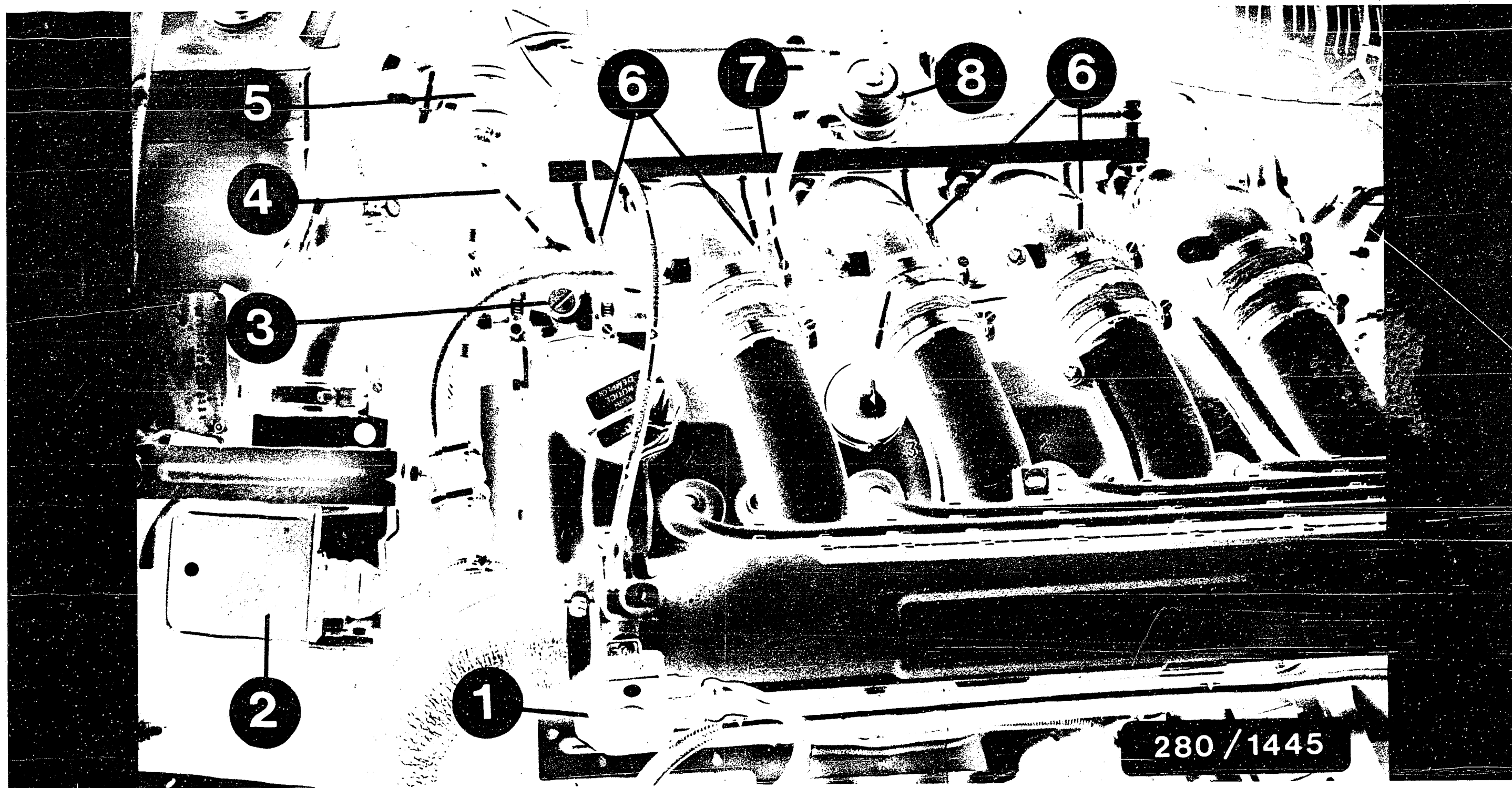
For production reasons:
continued on the following
coordinate.



1 = Central ground
2 = Control relay

The indications "right" and "left" always refer to the
forward direction of travel.

* Control relay (blue) is positioned near to the right-
hand headlight. It is protected by a plastic sleeve.



1 = Throttle-valve switch
 2 = Air-flow sensor
 3 = Idle adjusting screw

4 = To temperature sensor (engine)
 5 = Cutoff valve
 6 = Solenoid-operated injection valves

7 = To auxiliary-air device
 8 = Pressure regulator

INSTALLATION POSITION OF COMPONENTS

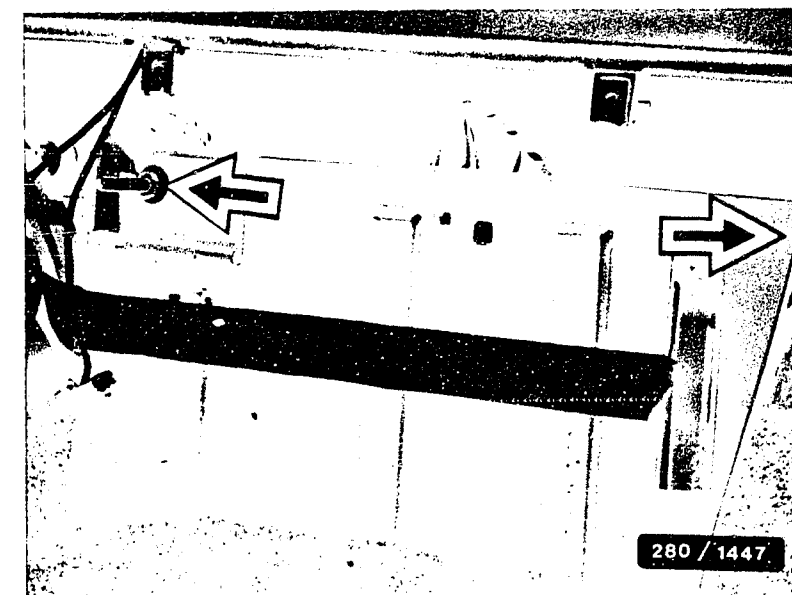
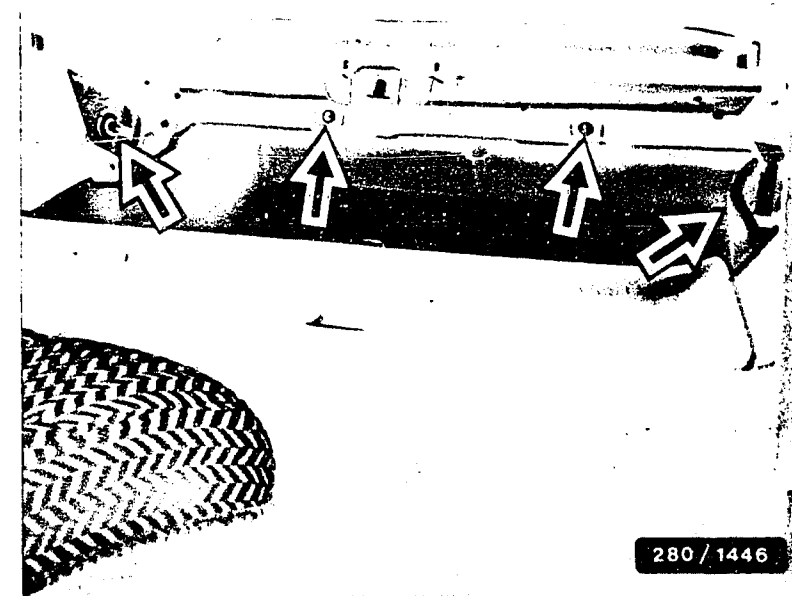
* LE2-Jetronic control unit is situated behind the glove box.

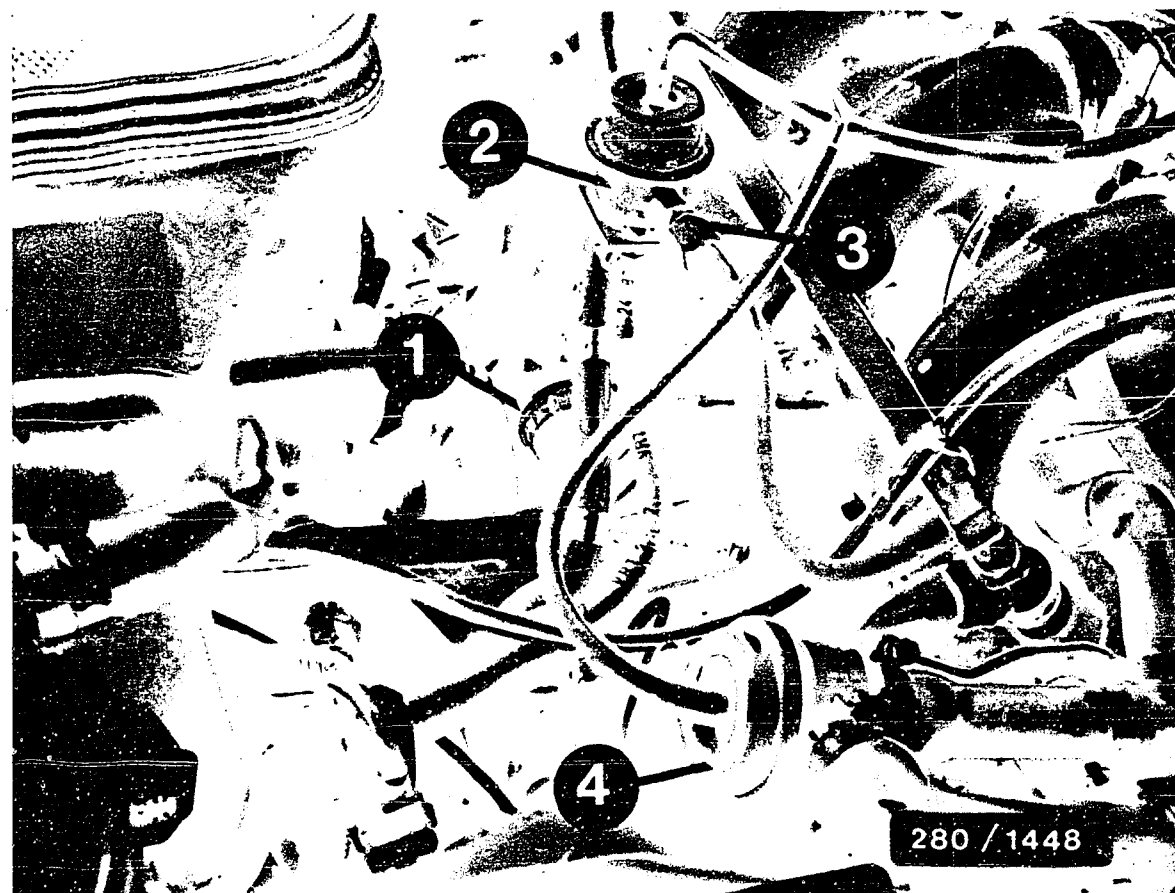
Instructions for removal: Release fastening screws (see upper illustration, arrows).
Pull out glove box forwards.
Pull away floor mat.
Release fastening nuts (see lower illustration, arrows) from floor panel.

Other components not shown

* Series resistors are situated on the right of the firewall beneath the spare wheel.

* Fuel pump is situated in front of the rear axle (cross member) on the right in a rubber mounting.





- 1 = Auxiliary-air device
- 2 = Pressure regulator
- 3 = Pressure-test connection
- 4 = Cutoff valve

TESTING THE FUEL PRESSURE

For testing the fuel pressure, use the pressure gauge and hose line of the pressure tester KDJE-P 100.

Connect the connecting piece KDJE-P 100/14 into the fuel-distribution-pipe intake and connect the hose line to the pressure gauge at the threaded connector on the side.

Caution. When opening the fitting, make sure that no fuel gets on to hot parts of the engine.

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions : CIT-5002
BOSCH system : LU2-Jetronic
Make of vehicle : CITROEN
Basic microcard : OPE-512

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Installation position of components.....	14

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle model with 2.498 l/4-cyl. engine:

Citroen CX 25 GTi Turbo 2 09.86->
with catalytic converter

- * LU2-Jetronic with 25-pin control unit
0 280 000 354
- * Engine-speed triggering by term. TD of the ignition control unit
- * 5-pin air-flow sensor
- * 7-pin control relay
- * Start control, i.e. additional injected fuel quantity via all solenoid-operated injection valves.
- * Lambda sensor for lambda closed-loop control and catalytic converter
- * Exhaust turbo-supercharger with intercooler
- * Cutoff valve provides direct connection from the air-flow sensor to the intake manifold. This prevents fluttering of the air-flow sensor. The valve is actuated by a vacuum and opens at a vacuum pressure exceeding 350 mbar.
- * For testing the fuel pressure, use the pressure gauge and hose lines of the pressure tester.
- * Connect connecting piece KDJE-P 100/14 into the fuel intake line.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 123

Test step	Switch		Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
1	5	—	1 — 5	TD pulses from ignition control unit	Shift into neutral, start engine	TD pulses on oscilloscope
2	6	—	9 — 5 (+) (-)	Voltage from control relay term. 87	Shift into neutral, start engine	8...15 V
3	7	—	4 — 5 (+) (-)	Voltage from ignition and starting switch term. 15	Shift into neutral, start engine	8...15 V
4	 V	11	8 — 5	Resistor set in air-flow sensor	—	100...200 Ω
5	 V	12	7 — 5	Resistance of potentiometer in air-flow sensor	Deflect air-flow sensor flap as far as it will go	60...1000 Ω
6	 V	13	10 — 5	Resistance, temperature sensor (engine)	+15...+30°C: Approx. +80°C:	1,45...3,3 k Ω 280...360 Ω
7	 V	14	13 — 5	Frame connection of output stage		0...10 Ω

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 123

Test step	Switch		Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
	V	Ω				
8	 V	15	25 - 5	Frame connection of sensors		0...10 Ω
9	 V	16	2 - 9	Resistance of idle contact	Disconnect control-unit plug from ignition control unit Accelerator pedal in rest position : Slightly depress accelerator pedal :	0...10 Ω Infinity Ω
10	 V	17	3 - 9	Resistance of full-load contact	Connect control-unit plug of ignition control unit Accelerator pedal in rest position : Fully depress accelerator pedal :	Infinity Ω 0...10 Ω
11	 V	18	12 - 9	Resistance of shunt- connected solenoid- operated injection valves and series resistors	+15...+30°C : Approx. +80°C :	5,0...9,0 Ω 5,1...9,25 Ω

REMARK: The following components with respective connecting leads are not covered by the universal test adapter for these tests:

- 1. Auxiliary-air device: positive lead from term. 87 of control relay, negative lead to engine ground.
- 2. Electric fuel pump: positive lead from term. 87b of control relay (via pump fuse), negative lead to vehicle ground.
- 3. Sensor heater: positive lead from term. 87b of control relay (via sensor fuse), negative lead to engine ground.
- 4. Lambda sensor: sensor lead to control unit term. 20 (shielding to term. 5), sensor housing to vehicle ground.

TEST SPECIFICATIONS

Component/function

Set values

Electric fuel pump

- * Fuel delivery and return:
- * Supply voltage under load:

at least 800 cm³ /30 s

at least 12 V

Pressure regulator

- * Fuel pressure with engine at standstill:
- at idle:

2,8...3,2 bar
approx. 0.5 bar lower

Fuel system, leakages

- * Fuel pressure after 20 mins. with engine at standstill:

at least 1.0 bar

Auxiliary-air device

- * Resistance value

35...70 Ω

Air-flow sensor

- * Resistance value between term. 8 and term. 5:
- term. 7 and term. 5:
- term. 9 and term. 5:
- term. 8 and term. 9:

340 ... 450 Ω
60 ... 1000 Ω 1)
500 ... 760 Ω
160 ... 300 Ω

1) (Fully deflect air-flow sensor flap)

Temperature sensor (engine)

- * Internal electrical resistance at ambient temperature +15...+30°C:
- With engine at warm. op. temp. approx. +80°C :

1,45...3,3 k Ω
280...360 Ω

Lambda-sensor heater

- * Internal electrical resistance (PTC) with engine at standstill:

1...15 Ω

TEST SPECIFICATIONS (Continued)

Component/function

Set values

Solenoid-operated injection valve

- * Internal electrical resistance at ambient temperature +15...+30°C:
- * Leakage after 60 s:

2...3 Ω
No drop must fall

Start control

- * Voltage at injection valve on initiation of starting: after approx. 15s:

Greater than 1.5 V
Approx. 0.5 V

Idle adjustment

- Engine at normal operating temperature, approx. + 80°C
- * Idle speed:

850...950 min⁻¹

CO adjustment

Not applicable thanks to lambda closed-loop cont.

Integrator voltage/test pin term. 22

- * Closed-loop control (connected sensor must be hot)
- Reading fluctuates between:
- * Open-loop control (pull apart sensor lead):

2 voltage values
Voltage reading must be equal to the mean value of fluctuation.

- * Rich value (pull apart sensor lead and apply control-unit side to ground):
- * Lean value (apply 2 V to control-unit side of sensor lead):

10...13 V
Less than approx. 0.5 V

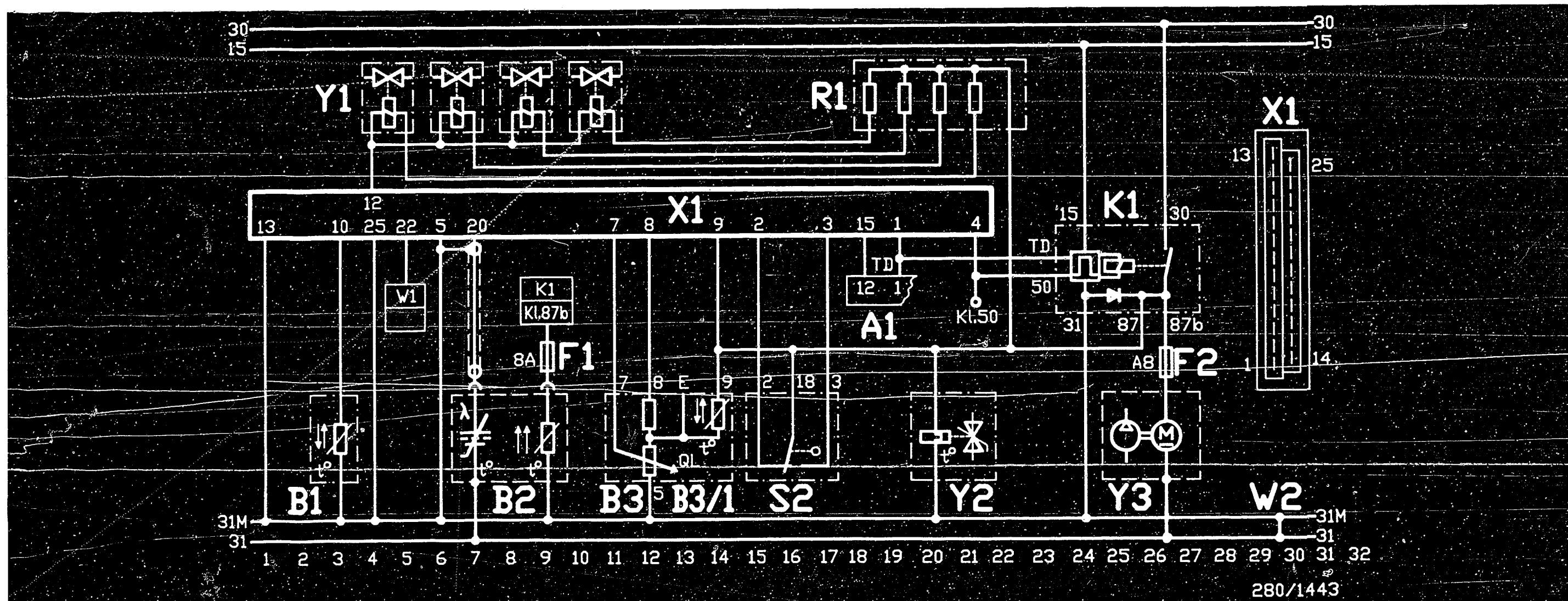
See equipment and Autodata microcards for settings for ignition, valve clearance and other engine-related data.

TEST SPECIFICATIONS (Continued)

Component/function	Set value
Series resistor	
* Electrical series resistance	3...5 Ω
Exhaust turbo-supercharger	
* Charge-air pressure at 5000 min -1	Max. 440 mbar
Cutoff valve	
* Vacuum exceeding 350 mbar	Open

See equipment and Autodata microcards for settings for ignition, valve clearance and other engine-related data.

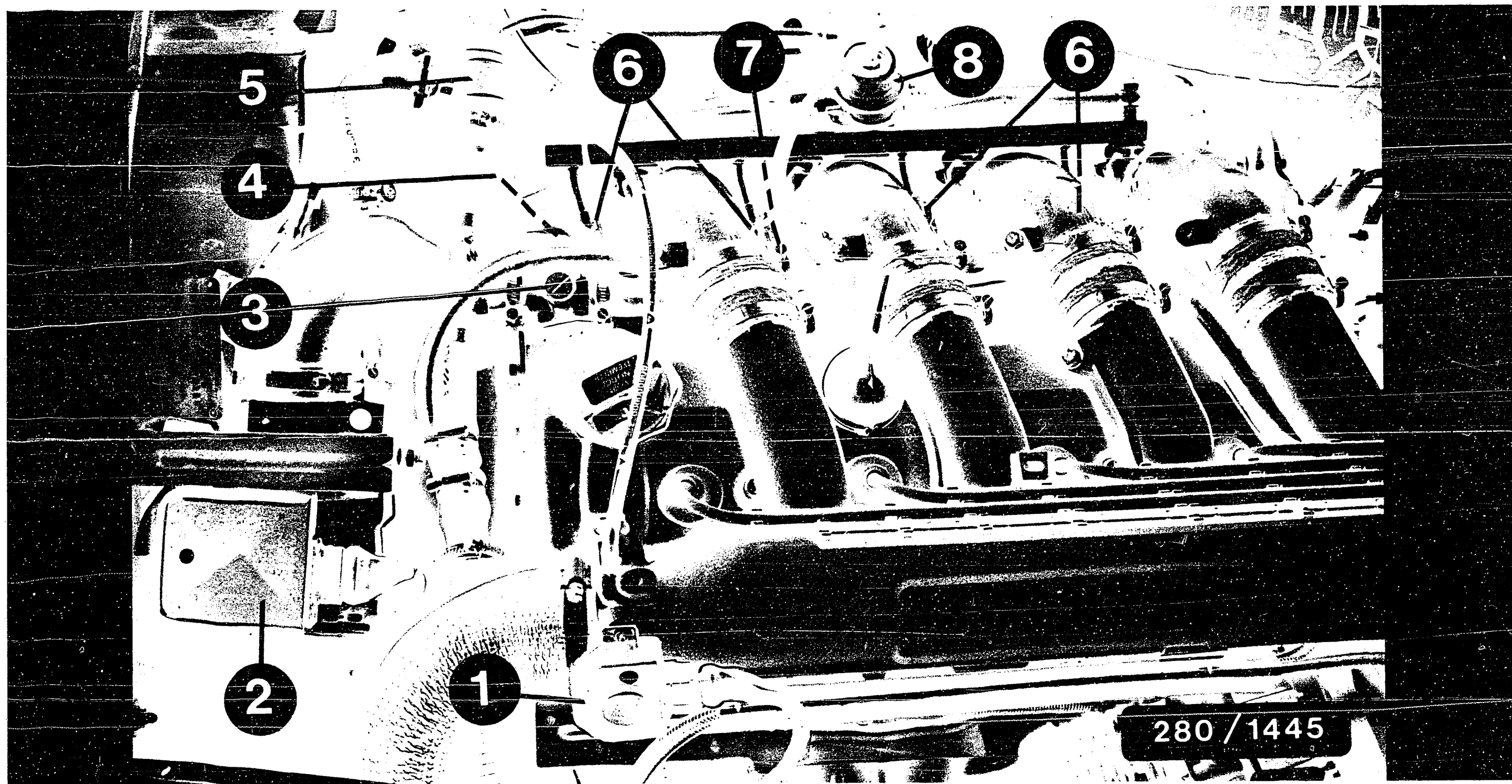
For production reasons:
continued on the following
coordinate.



A1 = Ignition control unit
 B1 = Heated lambda sensor
 B2 = Temperature sensor (engine)
 B3 = Air-flow sensor
 B3/1 = Temperature sensor (intake air)
 F1 = Fuse (electric fuel pump)
 F2 = Fuse (sensor heater)
 K1 = Control relay

R1 = Series resistors
 S2 = Throttle-valve switch
 W1 = Test pin/integrator voltage
 W2 = Ground strap, engine
 X1 = Control-unit plug
 Y1 = Solenoid-operated injection valves
 Y2 = Auxiliary-air device
 Y3 = Electric fuel pump

ELECTRICAL TERMINAL DIAGRAM



1 = Throttle-valve switch
 2 = Air-flow sensor
 3 = Idle adjusting screw

4 = To temperature sensor (engine)
 5 = Cutoff valve
 6 = Solenoid-operated injection valves

7 = To auxiliary-air device
 8 = Pressure regulator

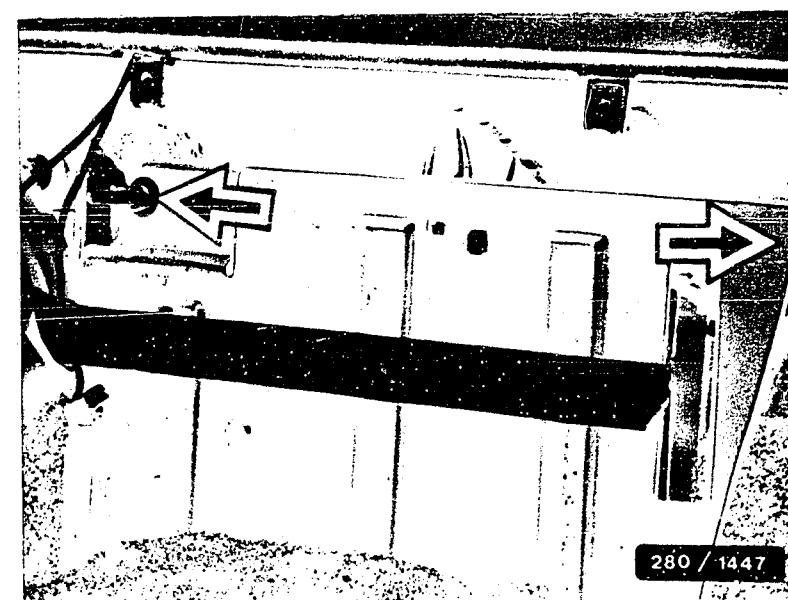
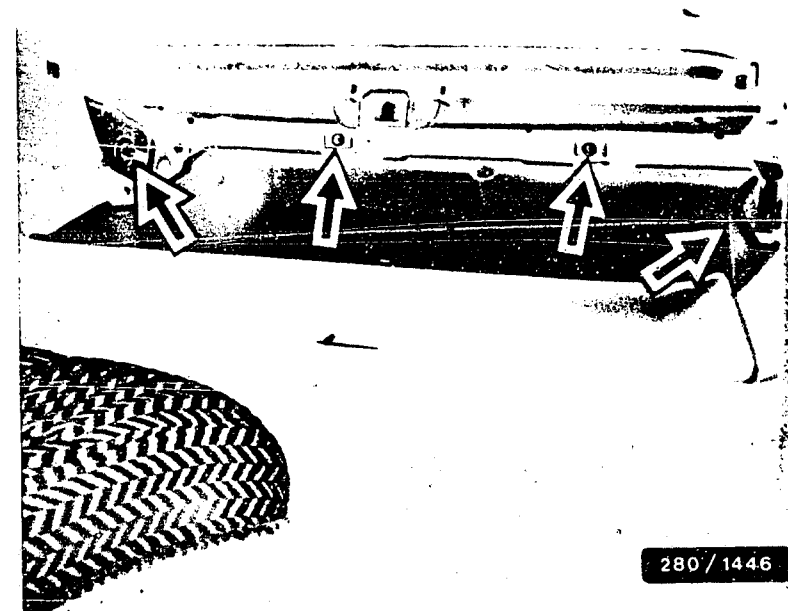
INSTALLATION POSITION OF COMPONENTS

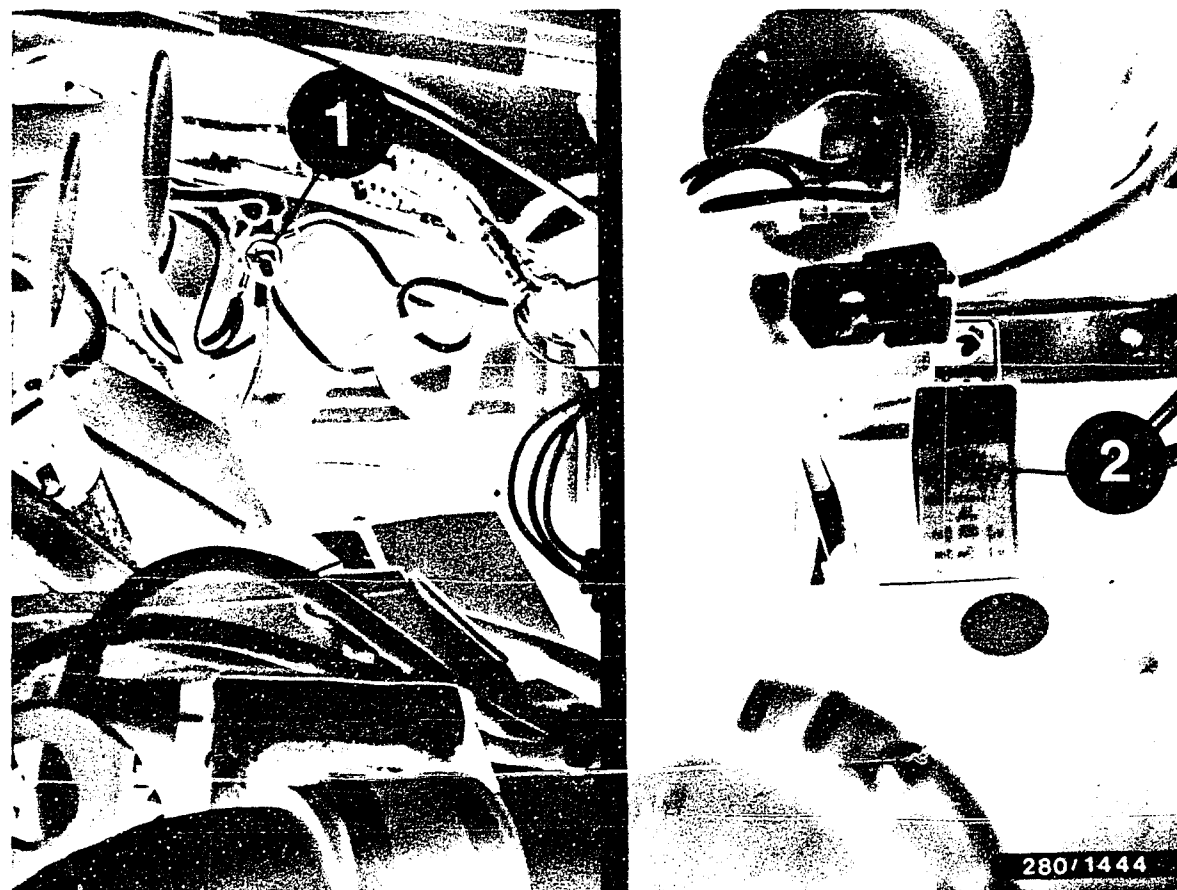
* LU2-Jetronic control unit is positioned behind the glove compartment.

Notes on removal: Loosen fastening screws (see upper illustration, arrows).
Pull glove compartment out forwards.
Pull away footwell matting.
Loosen fastening nuts (see lower illustration, arrows) from floor panel.

Further components not illustrated

- * Series resistors are located on the right-hand side of the firewall beneath the spare wheel.
- * Test pin (integrator voltage) is located near to the battery.
It is a 2-pin plug (color: light brown).
Light brown lead = Ground (-)
Green lead = Positive (+)
- * Lambda-sensor plug is located near to the battery.
- * Lambda sensor is positioned in the exhaust pipe upstream of the catalytic converter.
- * Fuel pump is positioned in front of the rear axle (transverse member) on the right-hand side in a rubber mounting.

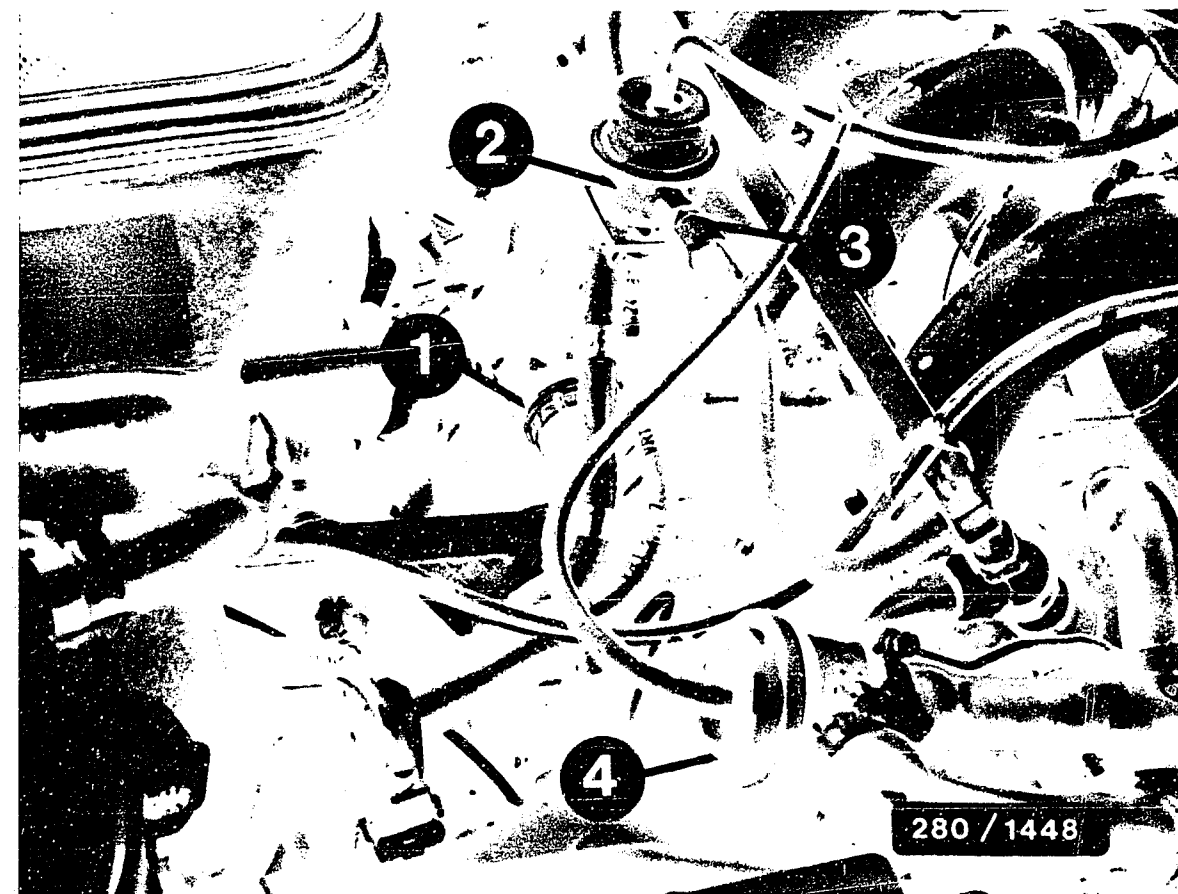




- 1 = Central ground
- 2 = Control relay

The indications "right" and "left" always refer to the forward direction of travel.

* Control relay (blue) is positioned near to the right-hand headlight. It is protected by a plastic sleeve.



- 1 = Auxiliary-air device
- 2 = Pressure regulator
- 3 = Pressure-test connection
- 4 = Cutoff valve

TESTING THE FUEL PRESSURE

For testing the fuel pressure, use the pressure gauge and hose line of the pressure tester KDJE-P 100.

Connect the connecting piece KDJE-P 100/14 into the fuel-distribution-pipe intake and connect the hose line to the pressure gauge at the threaded connector on the side.

Caution. When opening the fitting, make sure that no fuel gets on to hot parts of the engine.

Trouble-shooting instructions : VOL-5003
BOSCH system : EZ-K
Make of vehicle : VOLVO
Basic microcard : PKW-045

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Special features, usage, safety	02
Trouble-shooting chart	04
Self-diagnosis test table	07
Rapid diagnosis chart	11
Test specifications	15
Electrical terminal diagram	17
Installation position of components, notes on removal and installation	19

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the Volvo model:

760 / 780 2.8 Injection
with 2.8 l / 6-cylinder engine 5. 86 ->
B 280 E (D,CH,S)
B 280 F (CAL, J, USA)

- * EI-K control unit 0 227 400 109,..133
0 227 400 110,..131
0 227 400 118,..132
- * Trigger box 0 227 100 124
(with current limitation)
- * Ignition coil 0 221 118 351
- * Self-diagnosis

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to prevent damage to the engine, trigger boxes, and control units, or to the ignition system, be sure to observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

When testing the compression, disconnect the trigger-box plug or apply ignition coil term. 4
f i r m l y to ground with auxiliary cable.

Note: Auxiliary cable must be interference-suppressed with at least 2 2k Ω .

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

												Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	*	Self diagnosis
*				*								High-voltage side
*				*								Ignition coil
*												Firing sequence
*												Voltage, trigger box
*												Voltage, primary circuit
*												Voltage, EI-K control unit
*												Engine-speed and reference-mark sensor
*												EI-K control unit, operation
*												Engine-speed signal (Jetronic)

TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

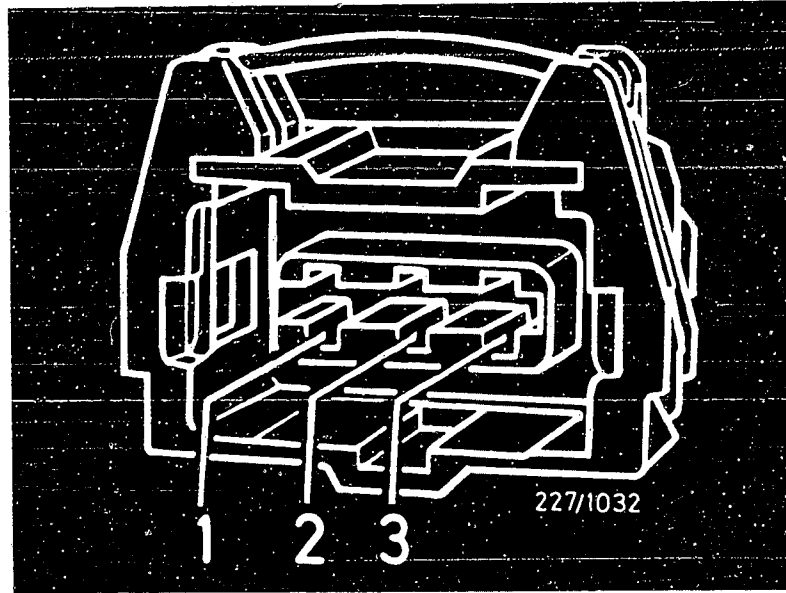
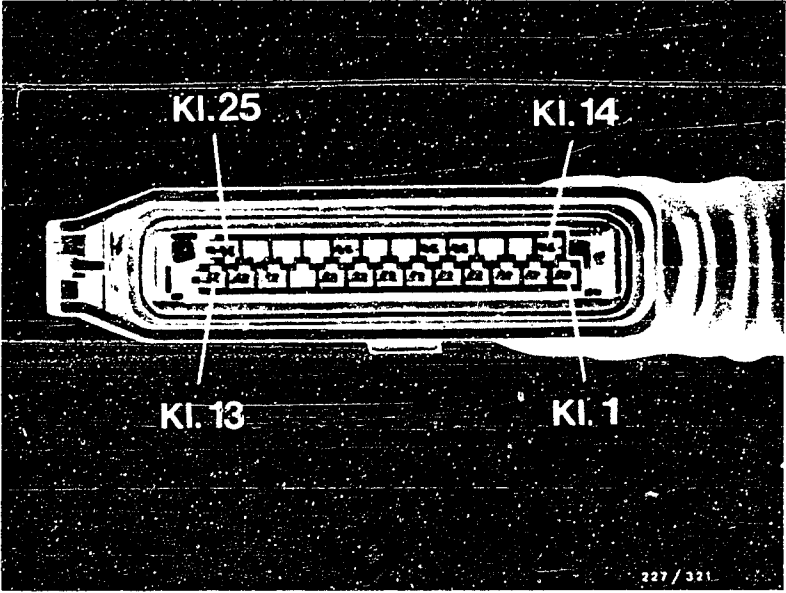
1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

										Cause (component fault)
*			*							Contact resistances (primary side)
	*	*		*	*					Throttle-valve switch - idle
	*	*		*	*		*	*	*	Spark-advance angle
			*							Voltage, EI-K control unit
			*							Voltage, trigger box (engine at idle)
			*							Voltage, ignition coil (engine at idle)
			*							Primary voltage (engine at idle)

For production reasons:
continued on the following
coordinate.

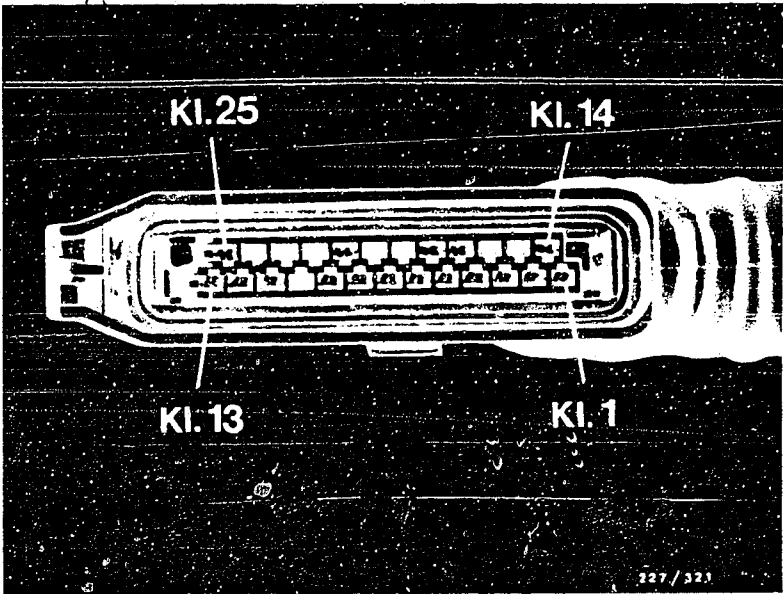
SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function Test instructions/conditions	Termi- nals	Set values
2	COOLANT-TEMPERATURE SENSOR Resistance, EI-K control-unit plug at temperature + 20° C + 30° C + 80° C + 90° C + 100° C	2 20	2,1...2,9 k Ω 1,4...2,0 k Ω 280...390 Ω 210...280 Ω 160...210 Ω
4	KNOCK SENSOR / EI-K CONTROL UNIT 1. Test both knock-sensor plug-in connections (lower illustration) for oxidation. 2. Resistance, EI-K control-unit plug and left-hand knock-sensor plug-in connection (cyl. 1, 2, 3) 3. Resistance, EI-K control-unit plug and right-hand knock-sensor plug-in connection (cyl. 4, 5, 6) 4. Resistance, EI-K control-unit plug	13 1 12 2 25 1 24 2 25 24 13 12	Approx. 0 Ω Approx. 0 Ω Approx. 0 Ω Approx. 0 Ω Infinity Ω Infinity Ω
5	LH-JETRONIC LOAD SIGNAL Resistance, EI-K control-unit plug and LH-Jetronic control-unit plug Voltage, EI-K control-unit plug with handle cover removed Engine at idle. ANALOG VOLTMETER (small measuring range). Briefly depress accelerator pedal to floor (snap acceleration). Watch voltmeter.	8 24 8 20 (+) (-)	Approx. 0 Ω 0,1...1,0 V Voltage increases slightly



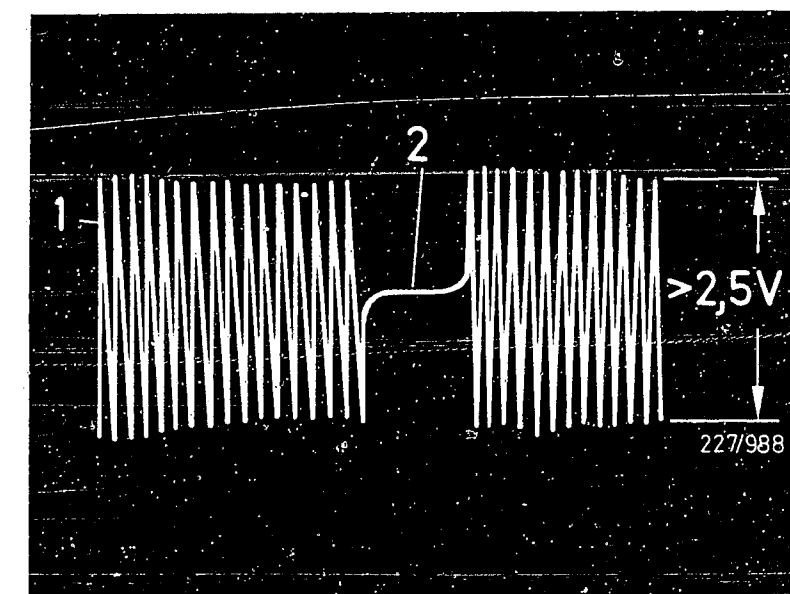
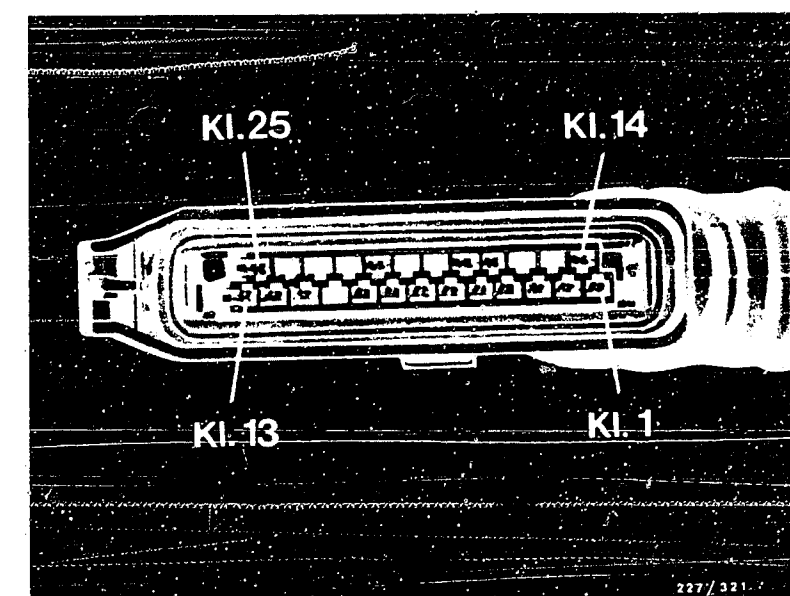
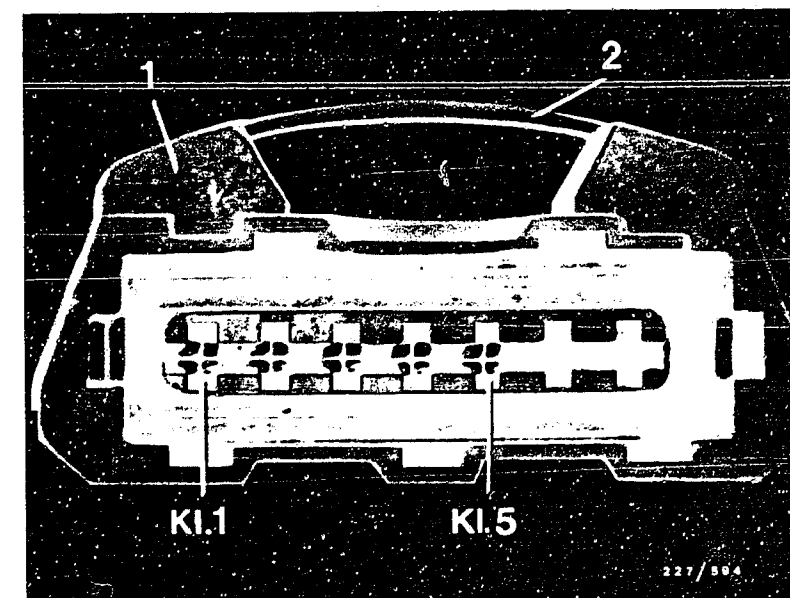
SELF-DIAGNOSIS TEST TABLE (Continued)

Fault indication Flashing code	Testing of component/function Test instructions/conditions	Termi- nals	Set values
6	Cylinder-detection sensor		
	Resistance, EI-K control-unit plug	18 19	Approx. 0 Ω
	Resistance, EI-K control-unit plug	19 21	Infinity Ω



RAPID DIAGNOSIS CHART

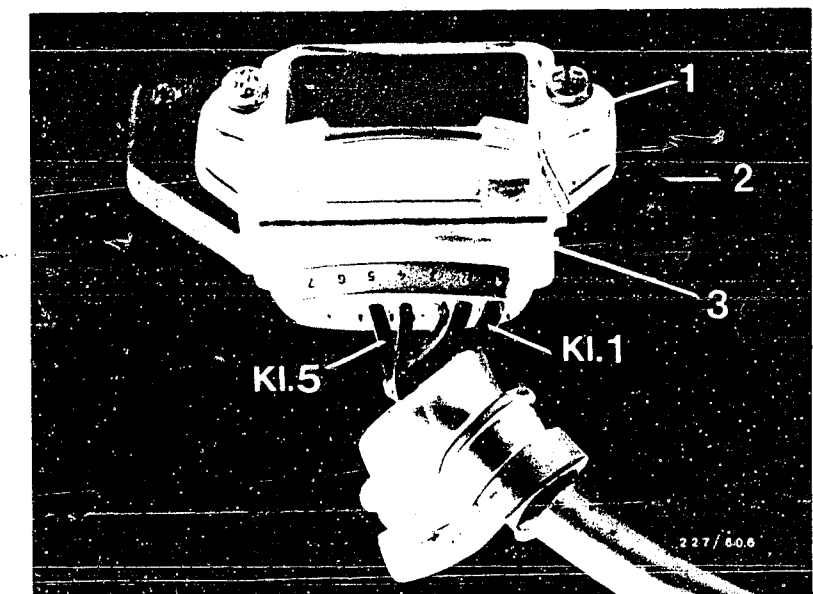
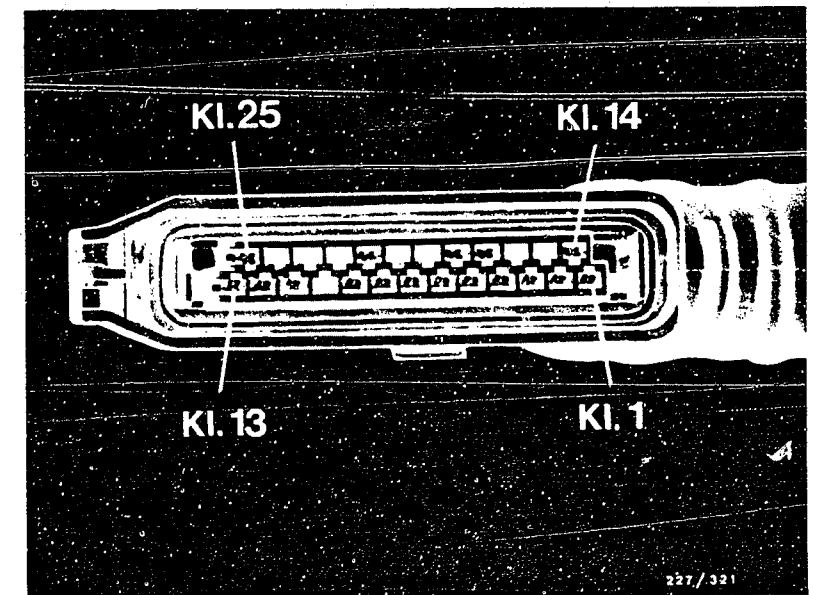
Test step	Testing of components/function Test instructions/conditions	Terminals	Set values
1	HIGH-VOLTAGE SIDE Visual examination (Distributor cap, ignition harness etc.) Ignition oscillogram	—	—
2	IGNITION COIL Visual examination, plug fitted, sealing compound escaped? Resistance, primary Resistance, secondary	1 15 1 4	0,6... 1,0 Ω 6,4...11,1 k Ω
3	VOLTAGE, TRIGGER BOX Ignition ON. Voltage, trigger-box plug (upper illustration).	4 2 (+) (-)	Approx. battery voltage
4	VOLTAGE, PRIMARY CIRCUIT Ignition ON. Voltage, trigger-box plug	1 2 (+) (-)	Approx. battery voltage
5	VOLTAGE, EI-K CONTROL UNIT Ignition ON. Voltage, EI-K control-unit plug (center illustration).	6 20 (+) (-)	Approx. battery voltage
6	ENGINE-SPEED AND REFERENCE-MARK SENSOR 1. Resistance, EI-K control-unit plug 2. Resistance, EI-K control-unit plug 3. Start engine. Signal EI-K control-unit plug	10 23 11 23 23 10 (+) (-)	445...790 Ω Infinity Ω Signal, see lower illustration.
7	EI-K CONTROL UNIT, OPERATION Start engine. Test signal, trigger-box plug and negative battery terminal	5 B- (+) (-)	Rectangular pulses
8	ENGINE-SPEED SIGNAL Start engine. Test signal, LH-Jetronic control- unit plug and negative battery terminal	1 B- (+) (-)	Rectangular pulses



RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of components/function Test instructions/conditions	Termi- nals	Set values
9*	CONTACT RESISTANCE Test voltage-supply lines of trigger box and primary circuit for contact resistance.	—	Max. 0.3 Ω
10	THROTTLE-VALVE SWITCH - IDLE Disconnect LH-Jetronic control-unit plug. Resistance, EI-K control-unit plug (upper illustration) Throttle valve in idle position	7 20	Approx. 0 Ω
11	VOLTAGE, TRIGGER BOX Engine at idle. Voltage, trigger-box plug with rubber sleeve pushed back (lower illustration).	4 2 (+) (-)	12...14 V, max. 1 V below U_B
12	VOLTAGE, EI-K CONTROL UNIT Engine at idle. Voltage, EI-K control-unit plug with handle cover removed.	6 20 (+) (-)	12...14 V, max. 1 V below U_B
13	VOLTAGE, IGNITION COIL Engine at idle. Voltage, ignition coil and vehicle ground.	15 31 (+) (-)	Min. 10 V
14	SPARK-ADVANCE ANGLE Engine at idle. Spark-advance angle of B 280 E engine Spark-advance angle of B 280 F engine	—	10...12 before TDC 15...17 before TDC
15	OUTPUT STAGE Ignition ON. Voltage, ignition coil	15 1 (+) (-)	0 V
16	PRIMARY VOLTAGE Voltage, ignition coil with engine at idle	15 1 (+) (-)	290...370 V

* Perform only when engine is not running.

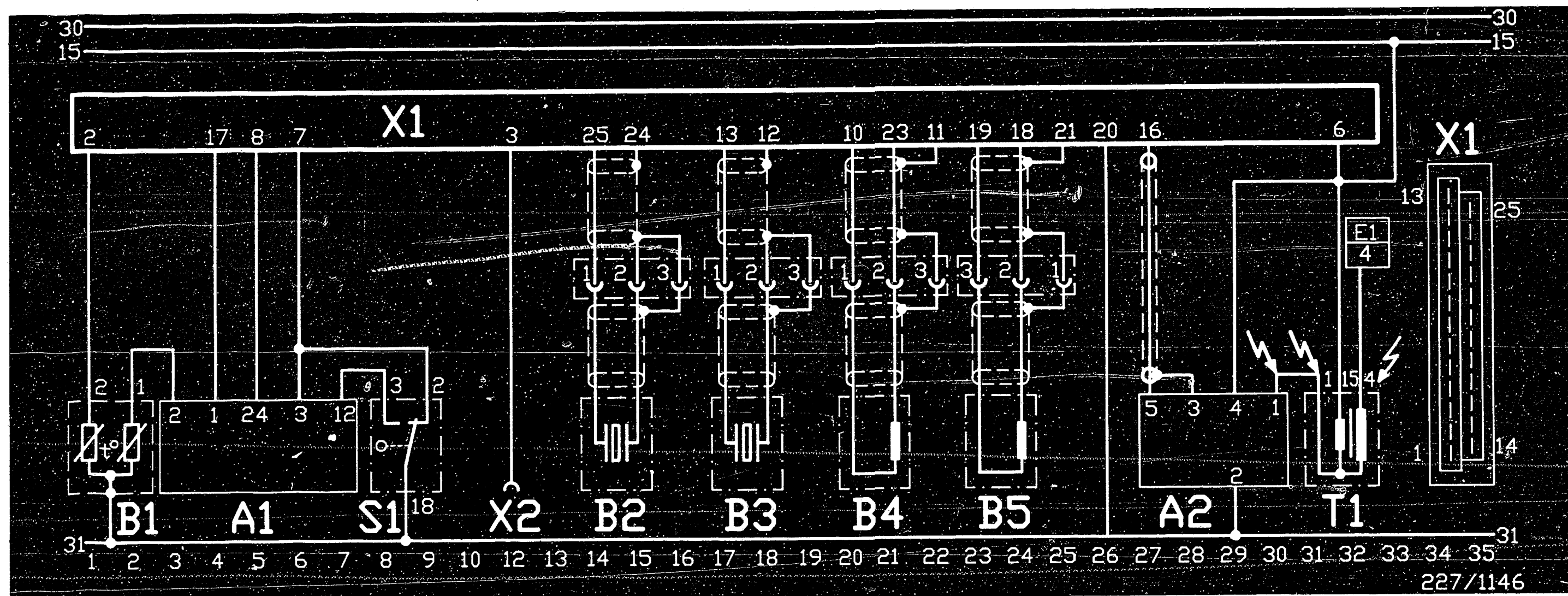


TEST SPECIFICATIONS

Ignition coil, primary	0,6...1,0 Ω
Ignition coil, secondary	6,4...11,1 k Ω
Coolant-temperature sensor	
Resistance at coolant temperature	
+ 20° C	2,1...2,9 k Ω
+ 30° C	1,4...2,0 k Ω
+ 80° C	280...370 Ω
+ 90° C	210...280 Ω
+100° C	160...210 Ω
Spark-advance angle with engine at idle	
B 280 E engine	10°...12° before TDC
B 280 F engine	15°...17° before TDC
Voltage, trigger box with engine at idle	12...14 V
Voltage, EI-K control unit with engine at idle	12...14 V
Voltage, ignition coil with engine at idle	Min. 10 V
Primary voltage with engine at idle	290...370 V
Throttle-valve switch with engine at idle	Approx. 0 Ω
Engine-speed sensor, insulation	Infinity Ω
internal resistance	445...790 Ω
voltage	U _{pp} greater than 2,5 V
Knock-sensor tightening torque	15...25 Nm

TEST SPECIFICATIONS (Continued)

Cylinder-detection sensor	Approx. 0 Ω
See SIS microcard Jetronic or Autodata test specifications for settings for idle speed, exhaust gas, valve clearance etc.	



High-voltage symbols : Danger, 400 V...25 kV

A1 = LH-Jetronic control unit

A2 = Trigger box

B1 = Coolant-temperature sensor

B2 = Knock sensor 2 (cylinders 4-5-6)

B3 = Knock sensor 1 (cylinders 1-2-3)

B4 = Engine-speed and reference-mark sensor

B5 = Cylinder-detection sensor

E1 = To high-voltage distributor

S1 = Throttle-valve switch

T1 = Ignition coil

X1 = EI-K control-unit plug

X2 = Diagnostic connector

ELECTRICAL TERMINAL DIAGRAM

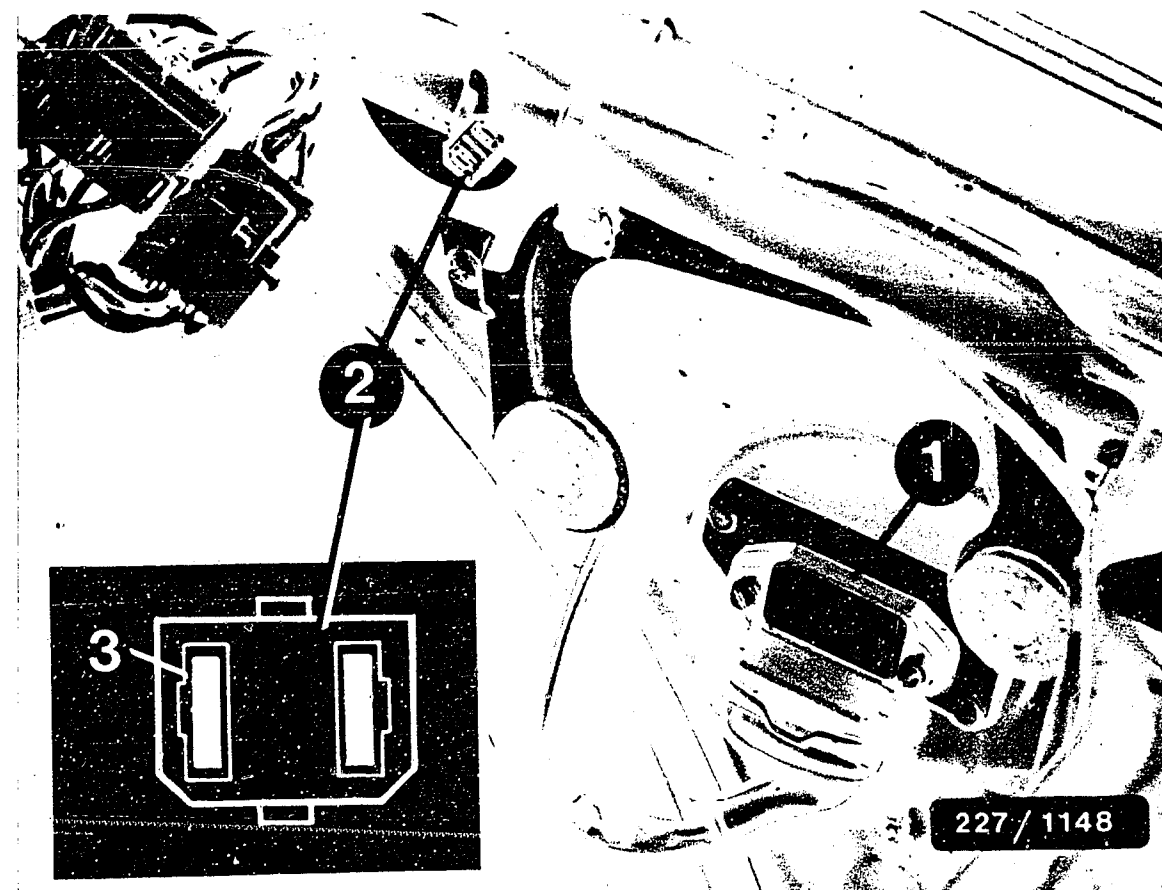


Arrow = EI-K control unit

INSTALLATION POSITION OF COMPONENTS

EI-K control unit is located behind the left-hand side panel (engine hood release).

Note on removal:
Remove steering-column covering.

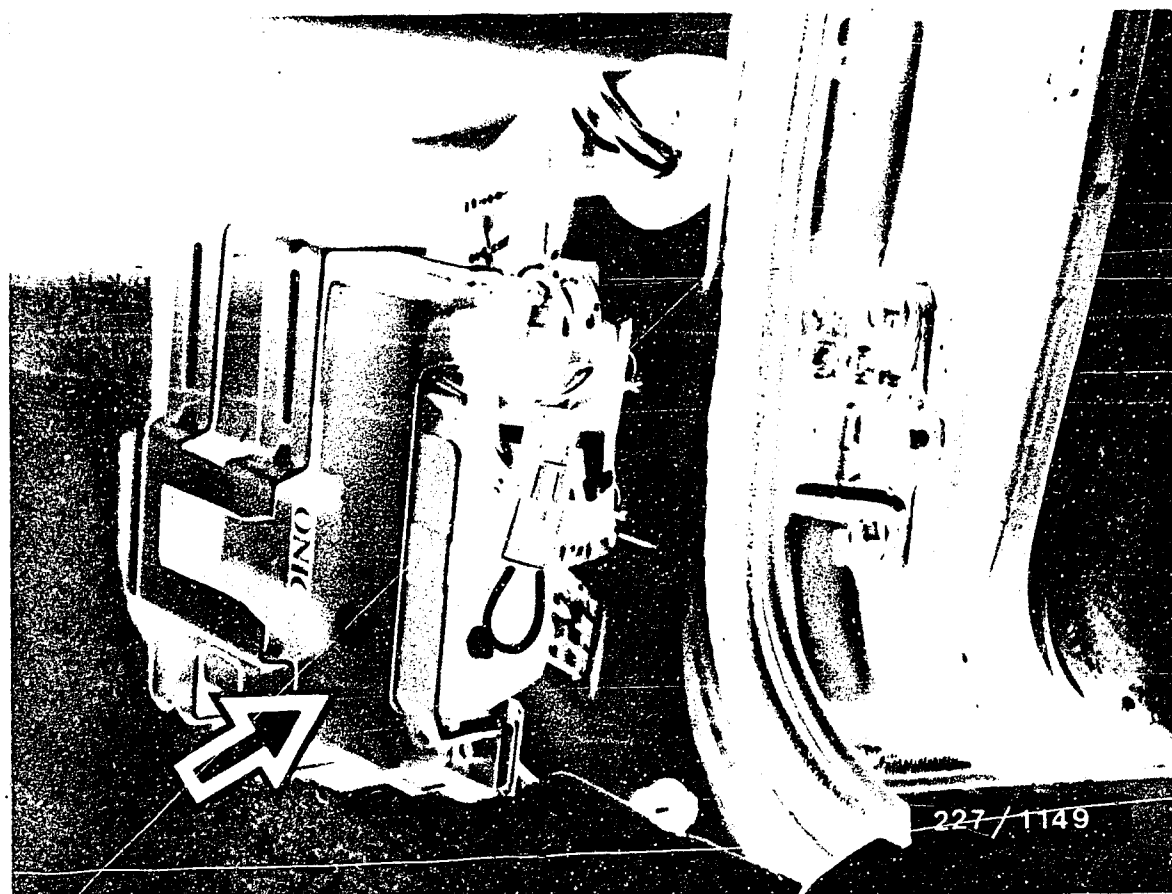


- 1 = Trigger box
- 2 = Diagnostic connector
- 3 = Diagnostic connection (yellow/red lead)

INSTALLATION POSITION OF COMPONENTS (Continued)

Trigger box and diagnostic connection are located front left on the vertical panel of the inner wing. See illustration.

Note on removal:
Remove air filter (plug-in connection).



Arrow = LH-Jetronic control unit

INSTALLATION POSITION OF COMPONENTS (Continued)

LH-Jetronic control unit is located front right on the door beam (lower A pillar).

Note on removal:
Remove side panelling.

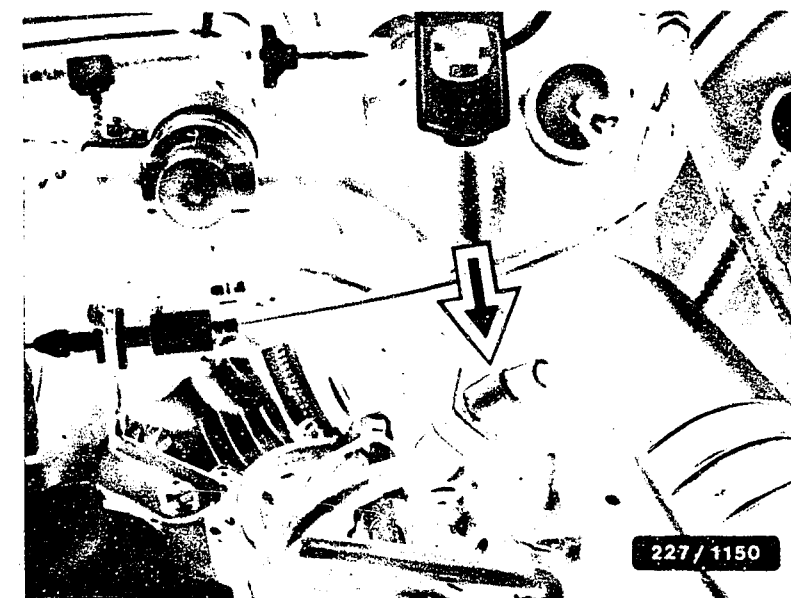
For production reasons:
continued on the following
coordinate.

INSTALLATION POSITION OF COMPONENTS (Continued)

Cylinder-detection sensor is pushed on to the H.T. lead of cylinder 1. See upper illustration, arrow.

Temperature sensor is located on the thermostat housing. See center illustration, arrow.

Engine-speed and reference-mark sensor is located at the rear of the engine. See lower illustration, arrow.

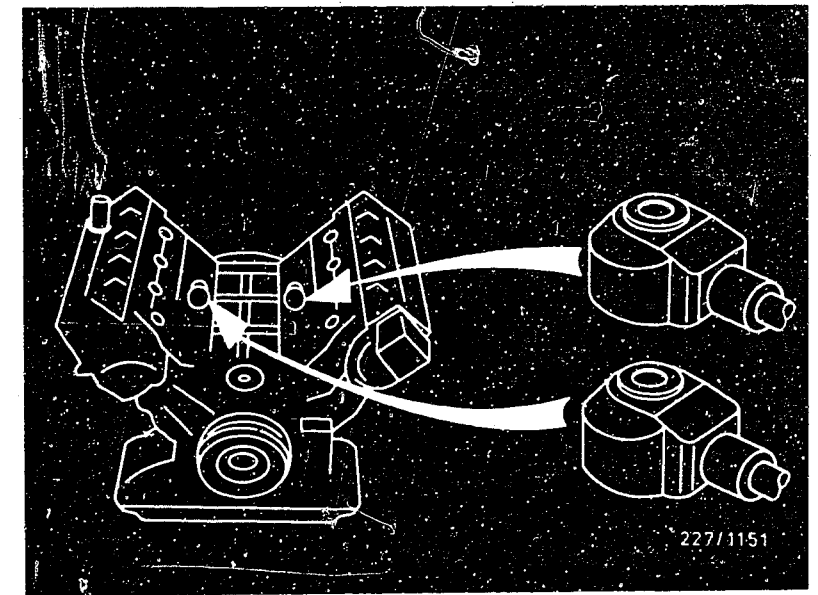


INSTALLATION POSITION OF COMPONENTS (Continued)

Knock sensors are located on the engine block.
See upper illustration, arrow.

Note on removal:
Remove fuel lines, electrical leads, injection valves and intake manifold.

Fit fastening screw of knock sensor without plain washer, spring lock washer, tooth lock washer or similar.
Tightening torque: 15...25 Nm.
Secure fastening screw with locking paint only.



Throttle-valve switch is located on the throttle-valve assembly.
See lower illustration, arrow.

